

**CARIBE PRODUCTS, INC.
SAN GERMAN, P.R. CONTAINER STORAGE UNIT
CONFIRMATION SAMPLING WORK PLAN AND
QUALITY ASSURANCE PLAN
EPA I.D. # PRD 091019224**

Prepared by:



Environmental Consulting & Technology, Inc.

**5405 Cypress Center Drive
Suite 200
Tampa, Florida 33609
(813) 289-9338**

APRIL 1992

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION AND PURPOSE	1
2.0 PROPOSED SCOPE OF WORK	3
2.1 <u>FINALIZE SCOPE OF WORK</u>	3
2.2 <u>PERFORM METHOD VALIDATION STUDY</u>	4
2.3 <u>COLLECT CONCRETE SAMPLES</u>	5
2.4 <u>SAMPLES ANALYSIS</u>	7
3.0 DATA REPORTING	9

APPENDICES

APPENDIX A -	STANDARD OPERATING PROCEDURE FOR METHOD VALIDATION
APPENDIX B -	QUALITY ASSURANCE PLAN ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC.
APPENDIX C -	ATI LEVEL III DATA VALIDATION STANDARD OPERATING PROCEDURES
APPENDIX D -	QUALITY ASSURANCE PLAN ANALYTICAL TECHNOLOGIES, INC.

1.0 INTRODUCTION AND PURPOSE

A concrete hazardous waste Container Storage Unit (CSU) at the Caribe General Electric Products, Inc. (CGE), San German facility is the subject of an approved closure plan previously submitted by CGE in accordance with the requirements of 40CFR 265.110 through 265.228, and Rule 805 of the Puerto Rico Environmental Quality Board (EQB), "Regulations for the Control of Hazardous and Non-Hazardous Solid Waste." The approved plan, entitled "Closure Plan for Container Storage Unit, EPA Facility I.D. #PRD 091019224," was prepared by Law Environmental Caribe in August 1989.

The Closure Plan report includes a description of the facility, CSU, waste inventory, and all proposed final closure activities. The Plan also summarized events and activities to be performed as part of the Plan so that the CSU unit at the San German Plant could be properly closed and certified. With the closure, CGE intends to become reclassified as a generator only, and not a storer of hazardous wastes.

Following U.S. Environmental Protection Agency (EPA) and EQB approval of the Plan, CGE retained Terra Vac, Inc. to perform the closure. In accordance with the approved Plan, Terra Vac submitted a certification report dated June 20, 1991 to EPA and EQB for review and formal certification of closure.

Upon review of the data contained in the report and subsequent correspondence, EPA and EQB concluded that Environmental Quality Technologies' analytical data could not withstand an audit validation from a quality assurance perspective. Therefore, EPA and EQB directed CGE to resample the cleaned CSU and analyze the concrete samples for two distinct parameter groups, referred to as Group 1 and Group 2.

EPA has directed CGE to identify analytical procedures and proposed method detection limits (MDLs), method quantification limits (MQLs), and practical quantification limits (PQLs), for methanol, n-butyl alcohol, and ethylene glycol monobutyl ether. EPA has also required CGE to provide the rationale for the proposed detection limits and the laboratory proposed to perform them. ECT will refer to these parameters as Group 1.

In addition, EQB expressed concern about ignitability, total cyanide, toluene, acetone, o-xylene, m-xylene, and p-xylene due to their finding that Environmental Quality Technologies' Standard Operating Procedures (SOPs) and quality assurance procedures (QA/QC) were inadequate. For this reason, EQB directed CGE to collect six additional samples and analyze those samples for these parameters, hereafter referred to as Group 2.

The purpose of this workplan is to precisely define the work which ECT will manage to satisfy EPA's and EQB's directives for additional confirmation data. The subsequent section defines the scope of work proposed by ECT, followed by quality assurance and SOP documentation. It has been prepared to satisfy the common requirement of both EPA and EQB that the plans be submitted for review and approval before implementation. **In accordance with this requirement, implementation of this proposed scope of work will not proceed until formal written approval of this plan, with modifications are required by EPA and EQB, is received by CGE.**

2.0 PROPOSED SCOPE OF WORK

In order to confirm that the work performed by Terra Vac in 1991 was sufficient to certify closure of the CSU, a second set of concrete samples is proposed to be collected from the floor of the CSU, and analyzed for both Group 1 (i.e., methanol, n-butyl alcohol, and ethylene glycol monobutyl ether) and Group 2 (ignitability, total cyanide, toluene, acetone, m-xylene, o-xylene, and p-xylene). Prior to performing this sampling and analytical effort, however, it will be necessary to first receive formal written EPA and EQB approval of the proposed scope of work, the field sampling and laboratory SOPs, the Quality Assurance Plan (QAP), and the MDLs, MQLs, and PQLs for the Group 1 parameters because the approved Closure Plan defines clean closure as below detection limits (BDL) for these parameters and because MDLs have not been published by EPA. Therefore, the MDLs, MQLs, and PQLs will be developed by completing a method validation study in the analytical laboratory prior to sampling. The following paragraphs define this proposed scope of work in detail.

2.1 FINALIZE SCOPE OF WORK

Prior to performing this proposed scope of work, EPA and EQB approval of the method validation study plan, the sampling and analysis SOPs, and the QAP is required. Therefore, CGE and ECT will await comment from both agencies before proceeding. Should EPA or EQB have comments about this package of information or require changes as a condition of approval, those changes will be incorporated into a final draft version of this plan which will then be distributed to EPA and EQB and serve as the workplan for the confirmation sampling and analysis. No additional work will be performed until formal written approval is received from EPA and EQB.

2.2 PERFORM METHOD VALIDATION STUDY

The approved Closure Plan established that analytical instrument detection limit (BDL) as the clean closure criteria for methanol, n-butyl alcohol, and ethylene glycol monobutyl ether. These criteria were proposed by CGE and approved by EPA and EQB because health-based levels have not been established for these parameters. The Group 1 parameters are neither listed as hazardous wastes, nor listed as Appendix VIII hazardous constituents and EPA has not published an approved analytical method for them in solid matrices.

Upon receiving EPA and EQB approval of this proposed scope of work, the first task will be to select analytical procedures, provide the rationale for the selection, and define the MDLs, MQLs, and PQLs for the Group 1 parameters. The selected methods will then be validated to provide statistical proof of method validity and precision and accuracy. Method validation will be performed in strict adherence to EPA procedures defined in Appendix B to Part 136 of 40 CFR, (1990) and the SOPs contained in Appendix A of this Confirmation Sampling Workplan. The validation procedure will consist of preparing seven replicate spiked samples of a reference sample of milled concrete and analyzing those samples for the Group 1 parameters. This procedure will be repeated until the actual detection limits prove that the original spike concentration utilized is within the 3 to 5 times estimated detection limit. Upon confirming the MDLs, MQLs, and PQLs, a data validation package will be prepared and submitted with the analytical results to EPA and EQB for critique and approval of the MDLs, MQLs, and PQLs for the Group 1 parameters.

ECT is proposing to contract with Analytical Technologies, Inc. of Pensacola, Florida (ATI - formerly Pioneer Laboratory) to perform this method selection and validation study and to perform all of the analyses required to complete the proposed scope of work. ATI is being proposed because of their experience in performing method validation for similar organic compounds in solid matrices. **ECT recognizes the**

proposed use of ATI is not consistent with the EQB requirements contained in Section III.G of EQB-LPCA-QAD-SAIP which prescribes that all results be officially sealed and signed by qualified chemists licensed by the Commonwealth of Puerto Rico and is requesting EQB to waive this requirement in advance. The reason for requesting this variance is that ECT has been unable to locate a laboratory in Puerto Rico which has experience in method selection and validation for similar parameters in a similar sample matrix.

Upon completion of the method validation study, the results will be forwarded to EPA and EQB for critique and comment as a separate deliverable together with a request for formal written approval of the method selected and the MDLs, MQLs, and PQLs determined by the study. No additional work on the project will be performed until formal written approval from both EPA and EQB is received.

2.3 COLLECT CONCRETE SAMPLES

Once the method validation study results are approved by EPA and EQB, Terra Vac, Inc. of San Juan, Puerto Rico will then replicate the sampling performed in 1991 by using the same procedures as six of the eight sampling locations previously utilized. The use of Terra Vac is proposed because the approved Closure Plan procedures were strictly adhered to by Terra Vac personnel in 1991 and the EQB quality assurance audit found no discrepancies in Terra Vac's sample collection and chain of custody procedures.

Figure 2-1 illustrates the proposed locations of the six sampling points. At each location, samples will be collected using the same procedures defined in the approved Closure Plan and followed in 1991. Sampling locations will be adjusted to ensure that undisturbed concrete is sampled by moving due east of the previous sample point to the immediately adjacent sampling block (one square foot). Two duplicate samples and one field blank will also be collected.

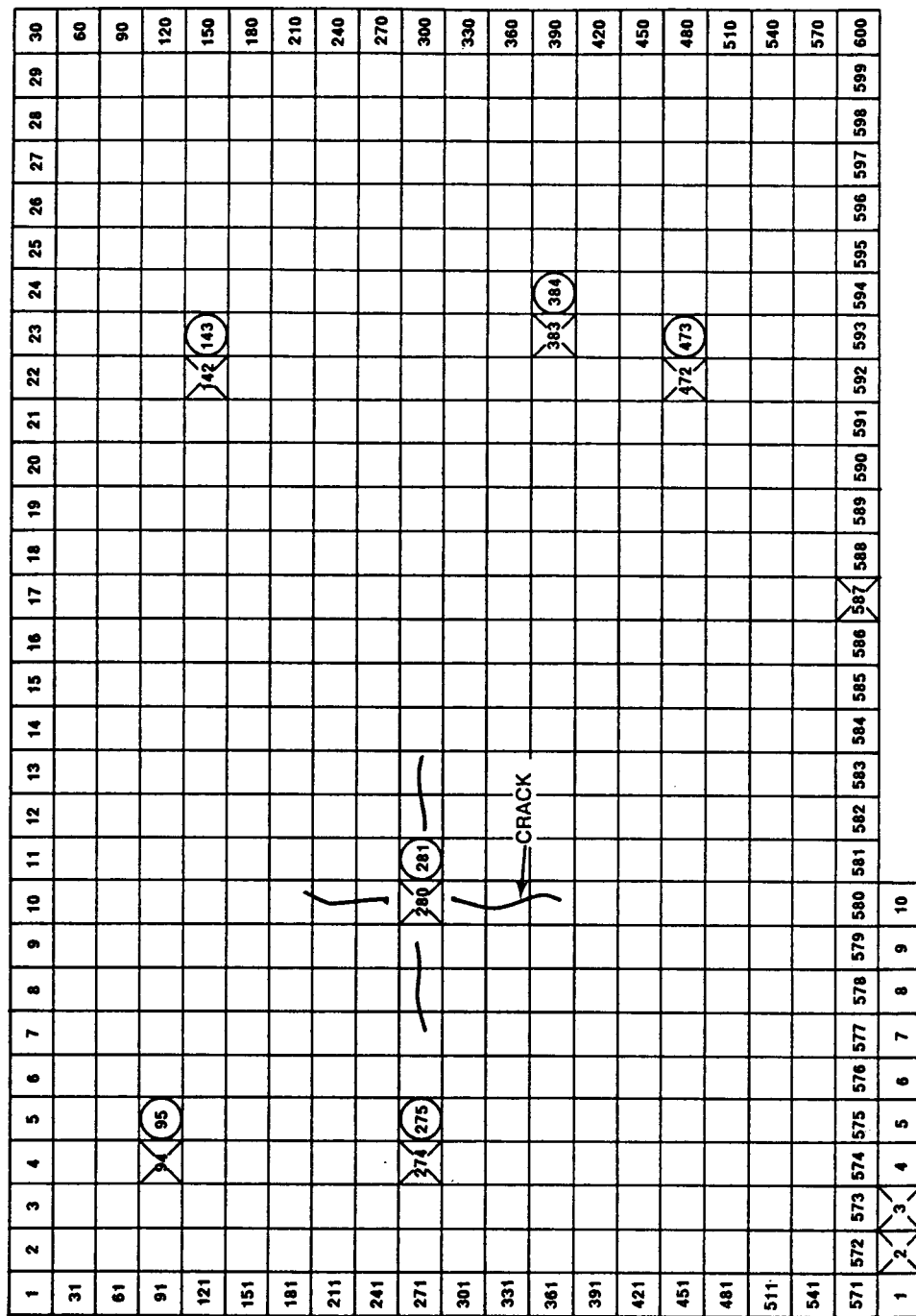


FIGURE 2-1.
SAMPLE LOCATIONS
GENERAL ELECTRIC
SAN GERMAN, PUERTO RICO
Source: ECT, 1992.

As an added quality assurance step, ECT personnel will monitor the onsite sampling by Terra Vac personnel to certify that the procedures followed meet the requirements of the approved Closure Plan, EPA-SW-846, and EQB-LPCA-QAD-SAIP, Number QAD-01. Appendix B contains the Quality Assurance Plan developed by ECT which will also be followed to further ensure the integrity of the samples.

2.4 SAMPLE ANALYSIS

ATI will analyze all nine samples for Group 1 parameters (methanol, n-butyl alcohol, and ethylene glycol monobutyl ether) using a gas chromatograph/flame ionization detector (GE/FID) assuming the method validation study results confirm the applicability of this method for these parameters. The Group 1 data report will include the reportables defined in the approved method validation report along with the measured value for each parameter.

In addition, ATI will analyze all nine samples for the Group 2 parameters using EPA approved methods and MDLs, as listed in Table 2-1. As shown in Table 2-1, these MDLs are less than the clean closure criteria established in the approved Closure Plan. For the Group 2 parameters, a Level III quality control data package will be provided to EPA and EQB in support of the reported results. The data to be reported as part of this package is presented in Appendix C.

In order to ensure the validity of the data, ATI will strictly adhere to the laboratory QAP, except where these quality assurance procedures are superseded by the method validation study requirements. ATI's QAP is enclosed as Appendix D.

Table 2-1. Proposed Parameters for Analysis

Parameter	Method	MDL for Solids	No. Samples	No. QC Checks**	Holding Time
Methanol	GC/FID	500 $\mu\text{g/kg}^*$	6	3	14 days
n-butyl alcohol	GC/FID	500 $\mu\text{g/kg}^*$	6	3	14 days
Ethylene glycol Monobutyl ether	GC/FID	500 $\mu\text{g/kg}^*$	6	3	14 days
Ignitability	SW-846-1010	100 C° max.	6	3	NP
Cyanide, total	SW-846-9010	250 $\mu\text{g/kg}$	6	3	14 days
Toluene	SW-846-8240	5 $\mu\text{g/kg}$	6	3	14 days
Acetone	SW-846-8240	10 $\mu\text{g/kg}$	6	3	14 days
Xylenes, total	SW-846-8240	4 $\mu\text{g/kg}$	6	3	14 days

Note: GC/FID = Gas Chromatograph/Flame Ionization Detector.
 * = Estimated detection limit pending performance of method validation study.
 ** = Consists of two duplicate samples and one equipment blank.
 NP = Not published. Literature suggests analysis within a minimum practical time frame.

Source: Analytical Technologies, Inc., 1992.

3.0 DATA REPORTING

Upon completion of the analytical procedures, Terra Vac will issue an addendum to the June 20, 1991 Closure Certification Report. This addendum will document the method validation study procedures, together with the procedures used to collect the samples and analyze for both the Group 1 and Group 2 parameters. The ATI analytical report and quality assurance data will be included in this report. The addendum will be forwarded to EPA and EQB for critique and approval within 90 days of sample collection.

The results of this resampling will be applied against the approved Closure Plan criteria. If the results indicate that none of the Group 1 or Group 2 parameters exceeds the closure criteria, the CSU will be considered closed and a request for certification from EPA and EQB will be forwarded. Should any of the Group 1 or Group 2 parameters exceed the approved closure criteria, CGE will then propose additional steps to complete the closure.

Table 2-1. Proposed Parameters for Analysis

Parameter	Method	MDL for Solids	No. Samples	No. QC Checks**	Holding Time
Methanol	GC/FID	500 μ g/kg*	6	3	14 days
n-butyl alcohol	GC/FID	500 μ g/kg*	6	3	14 days
Ethylene glycol Monobutyl ether	GC/FID	500 μ g/kg*	6	3	14 days
Ignitability	SW-846-1010	100 C° max.	6	3	NP
Cyanide, total	SW-846-9010	250 μ g/kg	6	3	14 days
Toluene	SW-846-8240	5 μ g/kg	6	3	14 days
Acetone	SW-846-8240	10 μ g/kg	6	3	14 days
Xylenes, total	SW-846-8240	4 μ g/kg	6	3	14 days

Note: GC/FID = Gas Chromatograph/Flame Ionization Detector.
 * = Estimated detection limit pending performance of method validation study.
 ** = Consists of two duplicate samples and one equipment blank.
 NP = Not published. Literature suggests analysis within a minimum practical time frame.

Source: Analytical Technologies, Inc., 1992.

APPENDIX A

**STANDARD OPERATING PROCEDURE
FOR METHOD VALIDATION**

APPENDIX A

STANDARD OPERATING PROCEDURE FOR METHOD VALIDATION

1. Scope

Method validation deals with the steps required to prove the efficiency of a new or revised method for analysis of a stated compound.

2. Discussion

The steps described are also covered in Florida Department of Environmental Regulation (FDER) Chapter 17-160 Quality Assurance under subsection 17-160.520 New Methods, Validation Requirements.

3. Reagents

Defined by method.

4. Apparatus

Defined by method.

5. Procedure

5.1. Write proposed procedure in a Standard Operating Procedure (SOP) format.

5.2. Choose a reference sample with similar matrix to the samples to be tested once the method is validated.

5.3. Spike seven (7) replicates of the reference sample with the compound of interest. The spike concentration is 3 - 5X the estimated detection limit.

5.4. Analyze the seven spikes by the proposed method following calibration with 3 - 5 standards and all Quality Control standards as described by the method, calculate the actual detection limit (3X the standard deviation of the seven results).

5.5. If the actual detection limit proves that the original spike concentration utilized was not within the range of 3 - 5X this detection limit, repeat steps 5.3 and 5.4 with the appropriate spike concentration.

5.6. A data validation package is prepared and contains the following:

-Method SOP

-All raw data including: sample preparation logs, strip chart recordings or chromatograms, analytical and instrument logs, and standard preparation logs.

-All quality control measurements including final and raw data for reagent blanks, method blanks, quality control check samples.

-All calibration standards including concentration, raw data, calculated response factors (if applicable), and calculated curves.

-All statistical calculations (detection limit study data) and final data reports.

6. QA/QC

As defined by method.

7. Interpretation of data

Refer to method SOP.

8. Safety

Refer to method SOP.

9. Waste Disposal

Refer to method SOP.

Division Employees must initial and date when SOP was read and understood.

<u>Sm 3/13/92</u>	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

APPENDIX B

QUALITY ASSURANCE PLAN
ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC.

SECTION 1.0

QUALITY ASSURANCE PLAN FOR RCRA CLOSURE SAMPLING SAN GERMAN, PURERTO RICO

Prepared For:
CARIBE GENERAL ELECTRIC PRODUCTS, INC.

P.O. Box 186
Zona Industrial El Retivo
San German, PR 00753
and

THE ENVIRONMENTAL QUALITY BOARD OF PUERTO RICO

National Bank Plaza
431 Ponce de Leon Avenue
Hato Rey, Puerto Rico 00910

Prepared By:
ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC.

5405 Cypress Center Drive
Suite 200
Tampa, Florida 33609
(813) 289-9338

91333-0700

Gary Uebelhoer; ECT Project Manager

Date

Lori A. Kotzer; ECT Quality Assurance Manager

Date

James J. Malot, P.E., Terra Vac & Associates Certifying Engineer

Date

2.0 TABLE OF CONTENTS

<u>Section No.</u>	<u>Title</u>	<u>Page</u>	<u>No. of Pages</u>	<u>Revision Date</u>
1.0	TITLE AND SIGNATURE PAGE	1-1	01	03/15/92
2.0	TABLE OF CONTENTS	2-1	05	03/15/92
2.1	<u>LIST OF TABLES</u>	2-4		03/15/92
2.2	<u>LIST OF FIGURES</u>	2-5		03/15/92
3.0	STATEMENT OF POLICY	3-1	02	03/15/92
3.1	<u>DOCUMENT CONTROL</u>	3-2		03/15/92
4.0	ECT ORGANIZATION AND RESPONSIBILITY	4-1	06	03/15/92
5.0	QUALITY ASSURANCE OBJECTIVES FOR PRECISION, ACCURACY, AND METHOD DETECTION LIMITS	5-1	02	03/15/92
5.1	<u>FIELD MEASUREMENTS</u>	5-1		03/15/92
6.0	SAMPLING PROCEDURES	6-1	29	03/15/92
6.1	<u>SAMPLE INTEGRITY</u>	6-1		03/15/92
6.2	<u>DECONTAMINATION PROCEDURES</u>	6-8		03/15/92
6.3.1	SOLID MATRICES SAMPLING	6-16		03/15/92
6.4	<u>SAMPLE PRESERVATION AND HOLDING TIMES</u>	6-22		03/15/92
6.5	<u>SAMPLE DISPATCH</u>	6-22		03/15/92
6.6	<u>FIELD REAGENT AND STANDARD STORAGE</u>	6-27		03/15/92
6.7	<u>FIELD WASTE DISPOSAL</u>	6-27		03/15/92
6.8	<u>ORGANIC-FREE WATER</u>	6-29		03/15/92

2.0 TABLE OF CONTENTS
(Continued, Page 2 of 3)

<u>Section No.</u>	<u>Title</u>	<u>Page</u>	<u>No. of Pages</u>	<u>Revision Date</u>
7.0	SAMPLE CUSTODY	7-1	03	03/15/92
7.1	<u>FIELD SAMPLE CONTROL OPERATIONS</u>	7-1		03/15/92
7.2	<u>SAMPLE TRANSPORT</u>	7-3		03/15/92
8.0	ANALYTICAL PROCEDURES	8-1	01	03/15/92
8.1	<u>FIELD METHODS</u>	8-1		03/15/92
9.0	CALIBRATION CONTROLS AND FREQUENCY	9-1	07	03/15/92
9.1	<u>FIELD MEASUREMENT EQUIPMENT</u>	9-1		03/15/92
9.2	<u>CALIBRATION STANDARD RECEIPT AND TRACEABILITY</u>	9-1		03/15/92
9.3	<u>PH METER</u>	9-3		03/15/92
9.4	<u>CONDUCTIVITY METER</u>	9-3		03/15/92
9.5	<u>TEMPERATURE METER</u>	9-3		03/15/92
9.6	<u>CALIBRATION FORMS AND RECORD KEEPING</u>	9-7		03/15/92
10.0	PREVENTATIVE MAINTENANCE	10-1	02	03/15/92
10.1	<u>ROUTINE MAINTENANCE</u>	10-1		03/15/92
10.2	<u>CONTINGENCY</u>	10-1		03/15/92
11.0	QUALITY CONTROL CHECKS, ROUTINES TO ASSESS PRECISION AND ACCURACY AND CALCULATION OF METHOD DETECTION LIMITS	11-1	07	03/15/92

2.0 TABLE OF CONTENTS
(Continued, Page 3 of 3)

<u>Section No.</u>	<u>Title</u>	<u>Page</u>	<u>No. of Pages</u>	<u>Revision Date</u>
11.1	<u>FIELD QUALITY CONTROL CHECKS</u>	11-1		03/15/92
11.1.1	DUPLICATE SAMPLES	11-1		03/15/92
11.1.2	EQUIPMENT BLANKS	11-3		03/15/92
11.1.3	TRAVEL (TRIP) BLANK	11-3		03/15/92
11.1.4	BLANKS FOR NON-AQUEOUS SAMPLES	11-4		03/15/92
11.2	<u>ROUTINE METHODS USED TO ASSESS PRECISION AND ACCURACY</u>	11-4		03/15/92
11.2.1	PRECISION	11-5		03/15/92
11.2.2	ACCURACY	11-6		03/15/92
11.2.3	COMPLETENESS	11-6		03/15/92
11.2.4	QUALITY CONTROL CHARTS	11-7		03/15/92
12.0	DATA REDUCTION, VALIDATION AND REPORTING	12-1	05	03/15/92
12.1	<u>DATA REDUCTION</u>	12-1		03/15/92
12.2	<u>DATA VALIDATION</u>	12-1		03/15/92
12.3	<u>DATA REPORTING</u>	12-4		03/15/92
12.4	<u>DATA STORAGE</u>	12-4		03/15/92
13.0	CORRECTIVE ACTION	13-1	02	03/15/92
13.1	<u>FIELD PROCEDURES</u>	13-1		03/15/92
14.0	SYSTEM AUDITS	14-1	06	03/15/92
15.0	QUALITY ASSURANCE REPORTS TO MANAGEMENT	15-1	01	03/15/92
16.0	RESUMES	16-1	44	02/06/92

2.1 LIST OF TABLES

<u>Table No.</u>	<u>Description</u>	<u>Page No.</u>	<u>Revision Date</u>
5.0-1	Field Measurements	5-2	03/15/92
6.1-1	Project Sampling Requirements	6-2	03/15/92
6.1-2	Sampling Equipment Restrictions	6-3	03/15/92
6.4-1	Recommended Container, Preservation and Holding Times for Solid Samples and Sediment Samples	6-26	03/15/92
6.6-1	Reagent/Standard Storage	6-28	03/15/92
9.1-1	Field Instrumentation Calibration Frequency and Calibration Standards	9-2	03/15/92
10.1-1	Routine Maintenance Activities	10-2	03/15/92
11.0-1	Minimum Field Quality Control Requirements	11-2	03/15/92
13.1-1	Corrective Actions	13-2	03/15/92

2.2 LIST OF FIGURES

<u>Figure No.</u>	<u>Description</u>	<u>Page No.</u>	<u>Revision Date</u>
4.0-1	Company Organization Chart	4-2	03/15/92
4.0-2	Project Organization Chart	4-3	03/15/92
6.3-1	Soil Sample Form	6-13	03/15/92
6.3-2	Boring Log	6-19	03/15/92
9.4-1	Multi-Calibration Log	9-4	03/15/92
12.2-1	Field Data Flow Chart	12-3	03/15/92
12.3-1	Document Review Sheet	12-5	03/15/92
14.0-1	Field Performance Audit Checklist	14-2	03/15/92

3.0 STATEMENT OF POLICY

It is the policy of Environmental Consulting & Technology, Inc. (ECT) that methods utilized to collect, analyze and evaluate field and laboratory data are consistent with the highest level of quality assurance and quality control (QA/QC) procedures. The QA/QC program of ECT includes provisions to ensure the following:

- Generation of data of a verifiable quality;
- Use of sound QA/QC management practices;
- Field data collection methodologies meet highest QA/QC standards and are documented;
- Field interpretations and analytical results are valid through proper sampling and analysis procedures;
- Sample identification and integrity are controlled by adherence to chain of custody protocol;
- Laboratory accuracy and precision of analyses are maintained by the specific laboratory identified in each Quality Assurance Plan (QAP), and
- Calculations and evaluations are accurate and documented.

All major environmental studies conducted by ECT involving the following tasks must be performed in accordance with a QAP.

1. Groundwater and surface water sampling;
2. Soil and sediment sampling;
3. Industrial hazardous and domestic waste sampling;
4. Air monitoring screening; and
5. Field (in-situ) analysis (e.g. pH, specific conductance, etc.).

3.1 DOCUMENT CONTROL

This document periodically will be revised as changes in personnel, procedures and equipment become necessary. Changes will be documented by the date and revision number of each section. When a section is revised, the revision date will replace the original date; the table of contents will be updated; and copies of pages with changes will be sent to everyone on the distribution list.

These procedures will apply once the plan has been finalized, approved by The Environmental Quality Board (EQB) and implemented. These procedures will not apply to draft documents.

4.0 ECT ORGANIZATION AND RESPONSIBILITY

ECT is a professional firm specializing in environmental consulting services which include identifying the presence of a contamination problem, defining site conditions and determining the extent of contamination; performing feasibility studies to determine effective cleanup methods; designing and implementing remedial measures; and long-term environmental monitoring. ECT services also include environmental investigations related to transactional and operational environmental audits, industrial facility sitings, and environmental impact studies.

ECT presently operates in the State of Florida from offices in Gainesville, Ft. Lauderdale, and Tampa. In addition, ECT also operates offices in Baton Rouge, LA, and Detroit, MI. Figure 4.0-1 represents the Corporate Organization with key personnel listed in each office. An organizational chart for the G.E. San German, Puerto Rico project is presented as Figure 4.0-2. Resumes of key individuals are presented in Section 16.

The ECT QA Officer is ultimately responsible for ECT's corporate QA/QC program. Operating autonomously, the ECT QA Officer reports directly to ECT's Corporate Officers and works closely with each of ECT's individual Office QA Managers. As QAPs are prepared by the various Office QA Managers, the ECT QA Officer will check and track the progress of these QAPs as they are reviewed, revised, and implemented.

The QA Manager for his or her office, reviews all QA/QC reports to the Project Manager and the client, and ensures that specific QA and primary technical operations are coordinated efficiently for a specific project. The QA Manager is independent of the project team and is responsible for the following:

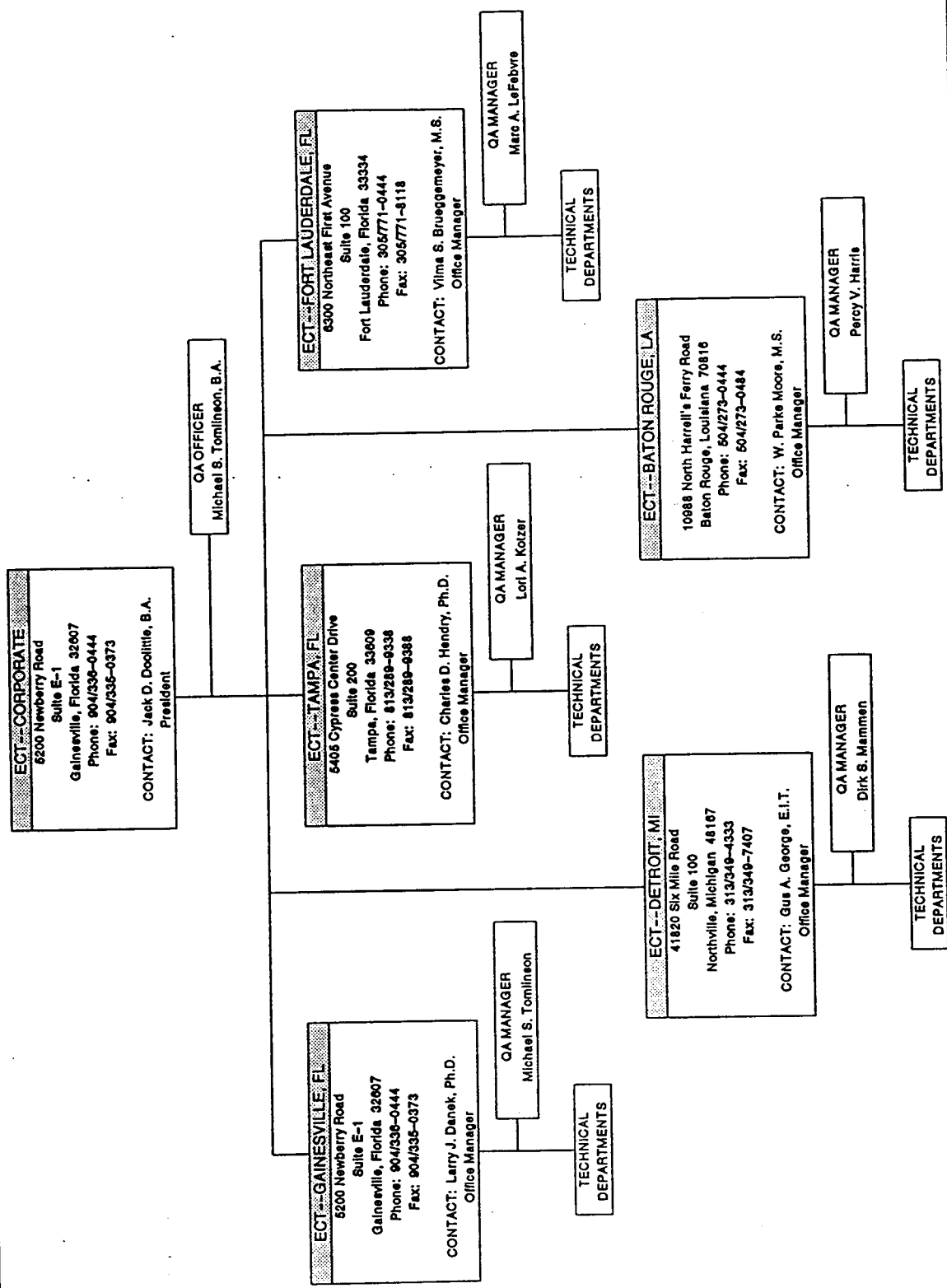


FIGURE 4.0-1.
ECT CORPORATION ORGANIZATIONAL CHART
CARIBE GENERAL ELECTRIC PRODUCTS, INC.
SAN GERMAN, PUERTO RICO
Source ECT, 1992

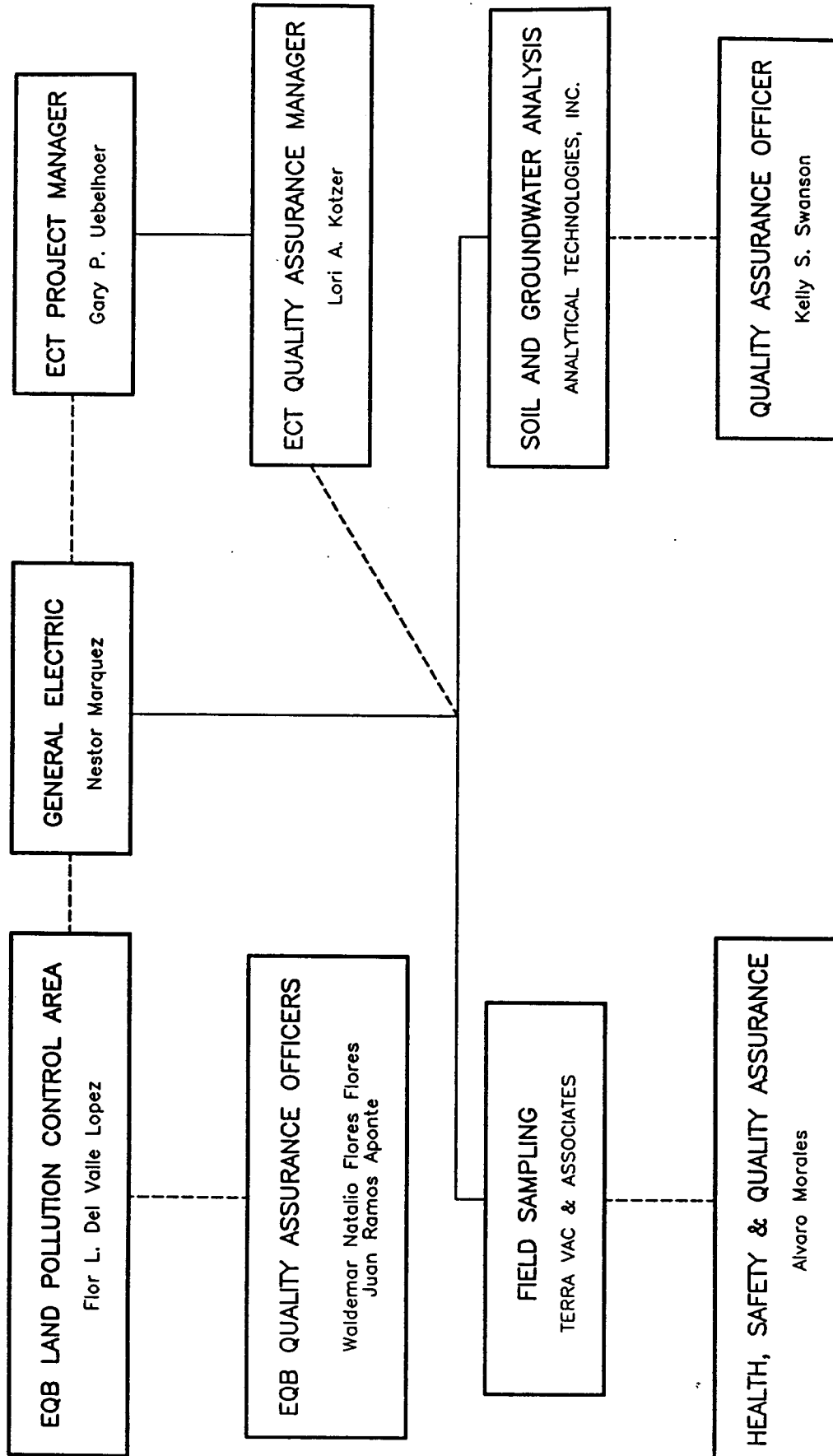


FIGURE 4.0-2.
PROJECT ORGANIZATION CHART
CARIBE GENERAL ELECTRIC PRODUCTS, INC.
SAN GERMAN, PUERTO RICO

Source ECT, 1982

ECT
Environmental Consulting & Technology, Inc.

1. Approval of all QA/QC procedures used on the project;
2. Compilation of the QAP Supplement Form which provides project-specific information;
3. Initiating system audits of field and engineering operations to assure compliance with the QAP;
4. Periodic review of field data or compliance with precision, accuracy, and completeness objectives;
5. Notification of the Project Manager and ECT QA Officer of any QC deficiencies discovered during audits;
6. Provision of guidance and coordination to rapidly resolve any QA/QC problems;
7. Maintenance of all project QA records and assembly of project QA data;
8. Independent review to assure the quality of all deliverables or outputs from the ECT project team to the client;
9. Interaction and communication with client QA personnel to resolve QA/QC problems specific to the project; and
10. Providing both oral and written QA/QC reports as described in Section 15.0 of this QAP.

For ECT projects, the Project Director is responsible for appointing the Project Manager, supervision of the manager in performance of project duties, and the provision of corporate support as needed. The ECT Project Manager is responsible for effective day-to-day management of the project staff as well as direct communication and liaison with the Environmental Quality Board of Puerto Rico and/or the client. The Project Manager's responsibility to QA is to assure that all project QC procedures are followed in the performance of the project.

The Task Managers are responsible for providing consistent and accurate field data and technical reports, produced by analysts, project scientist or engineers, and sampling personnel under his supervision. This individual is responsible to the Project Manager to assure that all personnel under his direction understand the QA/QC requirements of the project, all QC and technical review procedures are followed, and documentation is provided.

It is the responsibility of all ECT project personnel as well as the project scientist and field team members to perform and document the required QA/QC procedures. ECT field team members must bring any unusual observation or analytical problem to the immediate attention of ECT's Task Managers and Project Manager.

5.0 QUALITY ASSURANCE OBJECTIVES FOR PRECISION, ACCURACY, AND METHOD DETECTION LIMITS

At this time, ECT does not perform laboratory analyses; however, field measurements are made regularly by ECT field teams. The various field components and measurement methods, as well as the specific applicable sample matrices and targets for precision and accuracy are presented in Table 5.0-1. The definitions and equations for precision and accuracy are presented in Section 11.0 of this QAP. Where there were currently insufficient data, ECT has presented the manufacturer's published values for accuracy.

ECT is not currently using any modified or alternative methods nor are there method detection limits (MDLs) for these specific field methods; therefore, none are listed in Table 5.0-1.

Table 5.0-1. Field Measurements

Parameter	Equipment	Matrix	EPA Method	Precision (RPD %)	Accuracy (%R)*
pH	Corning M90 Checkmate®, Hydrolab Surveyor II®	Water+	150.1	2 ±2.5	103 ±6.17
Temperature	Corning M90 Checkmate®, Hydrolab Surveyor II®	Water+	170.1	1 ±0.88	±0.5°C**
Specific conductance	Corning M90 Checkmate®, Hydrolab Surveyor II®	Water+	120.1	1 ±1.22	98 ±5.64
Dissolved oxygen	Corning M90 Checkmate®, Hydrolab Surveyor II®	Water+	360.1	NA	±0.2 mg/L
Oxidation-reduction potential	Corning M90 Checkmate®, Hydrolab Surveyor II®	Water+	SM 2580	NA	±1 volt**

Note:

* = Unless otherwise indicated.

+ = Water is defined as: groundwater, surface water, drinking water, or wastewater effluents.

** = Manufacturer's specifications for accuracy.

NA = Precision not available due to insufficient field data.

mg/L = milligrams per liter.

RPD = Relative percent difference.

% R = Percent recovery.

6.0 SAMPLING PROCEDURES

6.1 SAMPLE INTEGRITY

The protocol for sampling procedures involved in solid matrix sampling is contained in this section. Table 6.1-1 is provided to list the sampling parameters by major category and by major analyte group.

ECT personnel are trained in accordance with approved sampling procedures as recognized by U.S. Environmental Protection Agency (EPA) Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual (ECBSOPQAM), Section 4.0, Revision 02/01/91. Sampling protocols conducted by ECT personnel are designed to ensure that representative samples will be collected and analyzed for forthcoming investigative reports.

Overall, the collection of a representative sample specifically includes the following elements:

- The sample collected is indicative of the area under investigation;
- The sample consists of the same physical and chemical characteristics as the medium to be represented;
- Proper sampling technique, sample handling, preservation, and quality control measures were employed;
- Strict adherence to the equipment restrictions, Table 6.1-2;
- Cross-contamination prevention includes collecting samples from the suspected least contaminated area to the suspected most-contaminated area, with background sample collection first;
- Non preserved sample containers and other sample collection equipment are rinsed with sample water before actual sample is taken;
- Uniquely identifying the collected samples and recording sample collection in field logbooks;

Table 6.1-1. Project Sampling Requirements

Parameter Group	Sample Source
Semivolatile organics	Concrete pad
Cyanide	Concrete pad
Ignitability	Concrete pad

Table 6.1-2. Sampling Equipment Restrictions, Materials, and Appropriate Use

Equipment Type	Use	Permissible Parameter Groups	Restrictions/Precautions
SOLID SAMPLING			
<u>Sediments/Soils</u>			
1. Core Barrel	Sampling	Metals VOCs Extractable organics	3 4,9 24
2. Trowel, scoop, spoon, or spatula	Sampling and compositing	Trace metals VOCs and extractable organics	1 2,5
3. Mixing tray	Compositing or homogenizing	Trace metals Extractable organics	1 10
4. Shovel	Sampling	Trace metals, VOCs, and extractable organics	6
5. Hand auger, bucket auger	Sampling	Trace metals, VOCs, and extractable organics	6
6. Split spoon	Sampling	Trace metals, VOCs Extractable organics	18,21 18
7. Shelby tube	Sampling	Metals VOCs Extractable organics	22 18 None

Source: ECT, Rev. 03/15/92.

Key to Restriction/Precautions:

- Equipment must be constructed of stainless steel or suitable non-metallic materials.
- Must be constructed of stainless steel or coated with Teflon®.
- Liners must be constructed of stainless steel or a suitable non-metallic material. If a carbon-steel liner is used with the core barrel, the samples for metals shall be taken from the interior part of the core sample.
- If samples are sealed in the liner for transport to the laboratory, the sample for VOC analysis must be taken from the interior part of the core.
- Samples for volatile organics should not be taken from composite (mixed) sample.
- Cannot be constructed of any metal other than stainless steel.
- If constructed of materials other than stainless steel, then a Teflon® insert must be used.
- If constructed of materials other than stainless steel, the sample for metals analysis must be taken from the interior part of the core sample.
- Liners may be constructed of stainless steel, Teflon®, glass, aluminum or other suitable liner of metallic construction.
- Must be constructed of stainless steel, Teflon®, glass or aluminum.

- Completing and maintaining chain of custody;
- Ensuring sample transport is secure; and
- The following order of sample collection is followed:
 1. Volatile organic carbons
 2. Total organic halogens (TOX)
 3. Total organic carbons (TOC)
 4. Extractable organics - includes total recoverable petroleum hydrocarbons (TRPH) and oil & grease
 5. Dissolved metals
 6. Total metals
 7. Cyanide
 8. Other inorganics

The ECT Project Manager and the ECT Quality Assurance Manager are responsible for ensuring that the above tactics will be demonstrated during each sampling event. As reassurance, each individual performing sampling functions will retain a copy of this section for his or her reference in field situations. All other pertinent reference material mentioned in this section is duplicated and available in the ECT office performing field sampling services.

Field quality control measures are routinely performed during all ECT supervised sampling events. A proper discussion will follow in Section 11.0. A duplicate sample is taken for every ten samples to evaluate the sampler's technique. Duplicate soil/water samples are obtained from successive volumes of sample water and from the same sampling device. This exercise to repeat the entire sampling procedure will promote greater sampling precision.

A second quality control measure for evaluating sample integrity and laboratory variability is the split sample. Taken from the same source and sent to separate laboratories, a split sample measures laboratory variability. Generally, to obtain a split sample, all sampling activities must be kept identical. When sampling a large matrix body (i.e. wastepile, lake, etc.) the sample should first be collected in an intermediate vessel and then split according to the same protocol. Since samples of a solid matrix (i.e. sediment and soils) are unlikely to represent a true split sample under field conditions, the recommendation is to consider them as duplicates. Overall, in order to achieve a *true* split-sample, the extraneous field and laboratory efforts such as dedicated equipment, preservation, and analyses must also be kept constant.

6.2 DECONTAMINATION PROCEDURES

Equipment used to collect samples must be free of contaminants in order to avoid misleading analyses. It is ECT's primary policy to use pre-cleaned sampling equipment in the field. Equipment that is questionable as to sufficiency of decontamination will not be used for sampling. Instead, field decontamination procedures will be utilized.

Specialized field equipment involved in the collection of more than one sample will require cleaning between samples. In such cases, field decontamination procedures will be applicable to the equipment and to the parameters of study. Deviations to the standard cleaning procedures must be approved by the ECT QA Manager and /or EQB QA Manager prior to the sampling event.

GENERAL EQUIPMENT:

Phosphate-free laboratory detergent	(2) Containers w/lids
Nitric Acid (10%) Solution	Aluminum foil
Pesticide grade isopropanol	Non-scented plastic lawn bags
Deionized water	Tap water

6.2.1 TELFLON AND GLASS SAMPLING EQUIPMENT

1. Clean with hot tap water and laboratory detergent use a brush to remove particulate matter if necessary.
2. Rinse thoroughly with hot tap water.
3. Rinse with nitric acid (HNO_3) solution. Be sure to capture the HNO_3 in a container for proper disposal.
4. Rinse thoroughly with tap water.
5. Rinse thoroughly with deionized water.
6. Rinse equipment thoroughly with isopropanol, use the second container to capture solvent for proper disposal. Air dry as long as 24 hours.
7. Wrap in aluminum foil or plastic lawn bag prior to next sampling event.
8. Record date and person performing decontamination.

6.2.2 STAINLESS STEEL OR METAL SAMPLING EQUIPMENT

1. Clean with hot tap water and laboratory detergent. Use a brush to remove particulate matter if necessary.
2. Rinse thoroughly with hot tap water.
3. Rinse thoroughly with deionized water.
4. Rinse equipment with isopropanol twice. Capture used isopropanol in the container for proper disposal. Allow to dry for 24 hours.
5. Wrap in aluminum foil or plastic lawn bag prior to next sampling event.
6. Record date and person performing decontamination.

6.2.3 FIELD CLEANING PROCEDURES FOR TEFLON , GLASS, STAINLESS STEEL OR METAL EQUIPMENT

1. Clean with tap water and laboratory detergent. Use a brush to remove particulates if necessary.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with deionized water.
4. Rinse twice with isopropanol. Capture used isopropanol in the container for proper disposal.
5. Rinse thoroughly with organic-free water. If organic-free water is not available allow to air dry as long as practical. Rinsing with deionized water is not permitted.

6.2.4 SAMPLE CONTAINERS

All sample containers shall be new and received from a reliable source. The subcontracted laboratory will provide the appropriate sample containers and assert the appropriate cleaning procedures are followed. All sample containers shall be cleaned according to the specified protocols listed in Table 6.2-1.

If equipment is known to be heavily contaminated, rinse with acetone or acetone-hexane-acetone before regular decontamination procedures begin. Dispose of properly if equipment cannot be cleaned.

Decontamination of various other field equipment may be necessary together with those mentioned above. Field organic-free water containers should be maintained and cleaned per U.S. EPA ECBSOPQAM guidelines for restrictions and procedures of field instrumentation, Appendix B, Subsection B1-B8, revision 02/01/91 for further discussions.

Table 6.2-1. Sample Container Cleaning Procedures

Analysis/Parameter	Cleaning Protocols (in order specified)
Extractable Organics (GC, HPLC, GC/MS and Total Phenols)	1, 2, 4, 6, (5 and 7 optional)
Purgeable Organics (VOCs) (GC, GC/MS, TOX)	1, 2, 4, (6 optional, methanol only), 7
Metals (Including Cr and Hg)	1, 2, 3, 4, 8
Inorganics (Including Cyanide, Alkalinity, Acidity, Residues, BOD, Color, Surfactants, COD, TOC, Chloride, Turbidity, Sulfate, Bromide, Sulfide, Fluoride, Nutrients and Radionuclides)	1, 2, 3*, 4, 8, 9 (* for nutrients, nitric acid should be replaced by hydrochloric acid, or hydrochloric acid may be used after the nitric acid rinse)
Oil & Grease (and TRPH)	1, 2, 3, 4, (5, 6, 7 optional)
Bacteriologicals	1, 2, 8, 10
Toxicity Tests (Bioassays)	1, 2, 11, 2, 4, 6 (10 optional)

Cleaning Procedures:

1. Wash with hot tap water and a brush using a suitable laboratory-grade detergent.
Organics-Liquinox, Alconox or equivalents
Inorganic anions-Liquinox or equivalent
Inorganic cations-Liquinox, Acatonox, Micro or equivalents
Bacteriologicals-must pass an inhibitory residue test.
Bacteriologicals-must pass an inhibitory residue test.
2. Rinse thoroughly with hot tap water.
3. Rinse with 1:1 nitric acid solution.
4. Rinse thoroughly with deionized water.
5. Rinse thoroughly with pesticide-grade methylene chloride.
6. Rinse thoroughly with pesticide-grade methylene chloride.
6. Rinse thoroughly with pesticide grade acetone or methanol (acetone only for bioassays).
7. Oven dry at 105° to 125° for at least 1 hour.
8. Invert and air-dry in contaminant-free environment.
9. Container is rinsed with sample.
10. Autoclave containers (the tops of which are covered with Al foil and autoclave indicator tape is applied to top-container seal).
11. Rinse with 10% HCl followed by a sodium bicarbonate solution.

NOTE:

- a) New container cleaning procedures may skip steps 1 and 2.
- b) This sheet does not represent all possible cleaning procedures, and deviations are accepted on a case by case basis.

Source: ECT, Rev. 03/15/92.

ECT personnel make a strong commitment to the prevention of cross contamination. Tubing, rope, and filtration units will only be of the disposable type for all ECT projects.

6.3 SAMPLING PROTOCOLS

The following is a list of equipment presently available to ECT personnel for groundwater/soil sampling event described by this section.

General Equipment List

Sample Kit	Disposable latex gloves
Corning Checkmate M90	Nylon tape measure
Buffer/standard solutions	Laboratory detergent
Deionized water	Organic vapor analyzer/flame-ionization detector
Isopropanol	Aluminum foil
Indelible ink pen	Two 5 gallon bucket

6.3.1 SOLID MATRIX SAMPLING

According to site conditions and the scope of the investigation solid matrix samples are frequently required. Solid matrix samples are typically collected from the surface and subsurface (either deep or shallow) of the land. Sample locations vary, but often include; path of surface run off,-down gradient and upgradient of points of interest, and in the area of suspect contamination. A representative solid matrix sample will provide additional information as to the condition of the subject area.

Specific Equipment List

Specific Log Sheet

Stainless steel spoons		Figure 6.3-1 Sample Log
Stainless steel hand augers	Stainless steel shovels	Figure 6.3-2 Boring Log
Stainless steel split spoons	Stainless steel scoops	
Shelby tubes	Stainless steel/glass pan	
Drill rigs with associated equipment		

(Refer to Table 6.1-2 for equipment and use restrictions.)

SOLID MATRIX SAMPLE INFORMATION

SAMPLING POINT: _____	PROJECT: _____
SAMPLE ID: _____	LOCATION: _____
SAMPLE DATE: _____	PROJECT NUMBER: _____
TIME: _____	TASK MANAGER: _____

DIAGRAM OF SAMPLE LOCATION(S):

SAMPLE PARAMETERS:

SAMPLING METHODS:

EQUIPMENT DECON PROCEDURE:

ODOR: _____ APPEARANCE: _____

NOTE ANY SAMPLING PROBLEM:

SAMPLED BY: _____ PROJECT MANAGER REVIEW: _____

FIGURE 6.3-1.
 SOLID MATRIX SAMPLE FORM
 CARIBE GENERAL ELECTRIC PRODUCTS, INC.
 SAN GERMAN, PUERTO RICO

Source: ECT, 1992.

ECT

Environmental Consulting & Technology, Inc.

BORING LOG TERMINOLOGY

	Symbol	Explanation
Boring Types	PH	Posthole
	HA	Hand Auger
	AB	Auger Boring
	TB	Test Boring
	TP	Test Pit
Sample Types and Tools	A	Auger
	SS	Split Spoon Samples
	RC	Rock Core
	TWT	Thin Walled Tube
	HSA	Hollow Stem Auger
	SSA	Solid Stem Auger
	N	Standard Penetration Test Blows per Foot (ASTM-1568)
Grain Size	F	Fine Grained (between #40 and #200 sieve for sand between 3/4" and #4 sieve for gravel)
	M	Medium Grained (between #10 and #40 sieve size)
	C	Course Grained (between #4 and #10 sieve for sand, between 3/4" and 3" sieve for gravel)
Description	TR	Trace
	LT	Light
	DK	Dark
	MED	Medium
	MOD	Moderate
Rock Cores	SS	Sandstone
	DOL	Dolomite
	LS	Limestone
General Notes	CS	Continuous Split Barrel Sampling
	DM	Drilling Mud
	SB	2" O.D. Split Barrel Sample
	W	Wash Sample
	P	Core Recovery-Percent
	CR	No Sample Recovered. Classification based on action of drilling equipment
	NR	and/or material noted in drilling fluid or on sampling bit.
		No Measurement Recorded
	NM	Not Detected
	ND	Rock
	RK	Fragments
	Frag	Very
	V	Below Grad
	BG	Grade
	G	End of Boring
	EPB	Carbonate Rock Fragments
	CRF's	

FIGURE 6.3-2.
BORING LOG (PAGE 1 OF 2)
CARIBE GENERAL ELECTRIC PRODUCTS, INC.
SAN GERMAN, PUERTO RICO
Source: ECT, 1992.

ECT
Environmental Consulting & Technology, Inc.

PROJECT NAME / LOCATION					PROJECT NUMBER:		BORING NUMBER:		SHEET OF			
					CONTRACTOR:				DRILLING METHOD:			
					DRILLER:				DRILLING RIG:			
					START:				COMPLETED:			
LAND OWNER:					SURFACE ELEVATION:				LOGGED BY:			
S A V E	T Y P E	S A M P L E	N U M B E R	B L O C K	S I T E	S I T E	S R A E M C P O L V E	D E P T H	DESCRIPTIONS OF MATERIALS AND CONDITIONS		C O N T A M I N A N T O B S E R V A T I O N	GENERAL OBSERVATION NOTES
SCALE 1"= 4'		I N S T R U M E N T	U N I T S									
								1				
								2				
								3				
								4				
								5				
								6				
								7				
								8				
								9				
								10				
								11				
								12				
								13				
								14				
								15				
								16				
								17				
								18				
								19				
								20				
								21				
								22				
								23				
BOREHOLE WATER LEVEL DATA												
DATE												
TIME												
GWL												
CASING DEPTH												

FIGURE 6.3-2.
BORING LOG (PAGE 2 OF 2)
CARIBE GENERAL ELECTRIC PRODUCTS, INC.
SAN GERMAN, PUERTO RICO
Source: ECT, 1992.

ECT
Environmental Consulting & Technology, Inc.

SURFACE AND SHALLOW SUBSURFACE SOLID MATRIX SAMPLING PROCEDURES:

1. Remove any surface vegetation with stainless steel equipment. Carefully set aside to replace after sampling is concluded.
2. Using pre-cleaned sampling equipment, carefully place sample into stainless steel or glass pan to thoroughly mix or composite if necessary. Samples to be analyzed for volatile organic compounds (VOC) should be placed directly into appropriate container and not mixed.
3. Examine the sample to record; color, texture, consistency, moisture content, and other pertinent characteristics.
4. If chemical analysis is required, use a dedicated stainless steel instrument to place the portion of the sample into an appropriate container. Place cap on container immediately.

DEEPER SUBSURFACE SOLID MATRIX SAMPLING PROCEDURE

1. Remove any surface vegetation with stainless steel equipment.
2. Advance pre-cleaned hollow stem or stainless steel bucket auger into the solid matrix until desired depth is reached. Collect sample with dedicated instrument and place in glass or stainless steel pan. VOC and oil & grease samples should be collected directly into sample container.
3. For obtaining samples with a stainless steel split spoon sampler, discard the top 2 to 3 inches of sample. Place undisturbed portion into a glass/stainless steel pan using dedicated instruments. Repeat until desired amount of sample is withdrawn.
4. Except for samples to be analyzed for volatile organic compounds, mix sample thoroughly and transfer into sample vessel.
5. Record data on Boring Log Data Form.

SOLID MATRIX SAMPLING PRECAUTIONS

- Decontaminate augers and split spoon sampler by pressure washing before proceeding to the next boring in prevention of cross contamination.
- Boring logs are also completed and should include interpretations of sample characteristics, conditions encountered, sample locations and any other notes pertaining to the solid matrix boring operation.
- The drilling contractor will not use petroleum-based lubricants on drill rods or sampling tools.
- Trace contaminant solid matrix sampling should proceed only with all stainless steel equipment.
- Volatile organic compound samples should not be mixed or composited.
- Avoid sampling from auger flights.

FOR DETAILED PROCEDURES REFER TO ANNUAL BOOK OF ASTM STANDARDS, SECTION 4.0, DESIGNATION: D 1586-84, PAGE 232-239, REVISION 1991 AND US EPA ECBSOPQAM, SECTION 4.11, PAGES 1-7, REVISION 02/01/91.

6.4 SAMPLE PRESERVATION AND HOLDING TIMES

The field team leader is responsible for proper sampling, labeling of samples, preservation, and shipment of samples to the laboratory to meet required holding times. Table 6.4-1 lists the recommended sample containers, preservatives, and holding times for soil and sediment samples. ECT will obtain all sample containers from the subcontracted laboratory. Samples which require an acid preservative to a specific pH will be verified in the field using pH paper. Any discrepancy will be properly documented in field logbooks and on chain of custody.

6.5 SAMPLE DISPATCH

At the completion of a sampling event, all collected sample containers will be prepared for transport back to the subcontracted laboratory. It is essential that the samples are packaged according to the following:

1. Temperature dependent samples are placed in cooler on a sufficient amount of wet ice to last the duration of transport time (maximum 4° C).
2. Sample containers shall be placed in upright position to prevent leakage.
3. When possible, separate glass containers with a means to prevent breakage (i.e. corrugated cardboard, vermiculite).
4. Containers destined for volatile organic carbon analysis will be transported in individually sealed containers (i.e., Ziplock baggies) to prevent cross-contamination.
5. Seal cooler/package properly if shipment is through a commercial courier service.
6. Always obtain courier's signature, date, and time on chain of custody. Report transport conditions in field logbooks.

Table 6.4-1. Recommended Containers, Preservation, and Holding Times for Soil and Sediment Samples

Parameter Group	Methods	References	Container	Preservation	Maximum Holding Time
Volatile Organics	Purge-and-trap GC and GC-MS	8010, 8015, 8020, 8021, 8230, 8040, and 8260	Glass, 40 ml vial or 4 oz. widemouth, with Teflon®/silicone septum ⁽²⁾	(3)	14 days
Semivolatile Organics	GC, HPLC, and GC-MS	8040, 8060, 8080, 8090, 8100, 8120, 8140, 8150, 8250, 8270, 8280, and 8310	Glass, 8 oz. widemouth with Teflon®-lined cap (50-grams sample)	(3)	14 days until extraction, 40 days after extraction
Total metals, except mercury and chromium VI	Flame AA, Furnace AA, hydride and ICP	All 7000-series methods (except 7195, 7196, 7197, 7198, 7470, and 7471) and 6010 (ICP)	Glass or plastic, 8 oz. widemouth (200-grams sample)	Cool, 4°C	6 months
Chromium VI	Colorimetric, chelation with Flame AA	7196 and 7197	Glass or plastic, 8 oz. widemouth (200-grams sample)	Cool, 4°C	24 hours
Mercury	Manual cold vapor AA	7471	Glass or plastic, 8 oz. widemouth (200-grams sample)	Cool, 4°C	28 days

(1) Adapted from Tables 3-1 and 4-1 in Test Methods for Evaluating Solid Waste, SW-846, EPA, Third Edition, 1986, and first update in 1987. The term residuals includes: (1) concentrated waste samples and

(2) sludges of domestic or industrial origin.

(3) Sample should not be homogenized (mixed) prior to filling container. Container should be filled by packing as much sample into it leaving minimal headspace. Field samples can not be composited for analysis.

(3) Soils, sediments, and sludges should be kept cool at 4°C from collection time until analysis.

No preservation is required for concentrated waste samples.

Source: DER QAS Guidance Document 90-02, 08/28/90.

6.6 FIELD REAGENT AND STANDARD STORAGE

In order to avoid cross contamination of buffer and standard solutions, it is ECT's policy that pH is consistently verified prior to use. pH paper will be used to identify any contamination in stock solutions of regulated pH. Stock solutions will remain in storage area at all times as described in Table 6.6-1. Any solution taken from stock will not be returned to the original solution container. All solutions brought into the field will display shelf-life and stock number if taken from standard source.

6.7 FIELD WASTE DISPOSAL

All waste generated by ECT personnel during a sampling event will be properly containerized and/or disposed of according to type of waste. Solvents, such as isopropanol, should be containerized for commercial disposal. Acids and bases must be diluted or neutralized first, then disposed of into a sanitary sewer source. Containerization and commercial disposal may be necessary if large amounts are generated. Lastly, all calibration standards and buffer solutions may be disposed of directly into sanitary sewer system.

If soil encountered during borehole drilling or test pit work is suspected to be hazardous because of discoloration, odor or air monitoring levels, the soil cuttings will be containerized in new, unused drums. The boring logs will indicate the depth(s) from which suspected soil cuttings were collected for containerization. ECT will determine the appropriate laboratory tests in order to determine acceptable disposal methodologies.

6.8 ORGANIC-FREE WATER

The organic-free water which ECT utilizes for field services will be obtained from the subcontracted laboratory. ECT maintains that organic-free water shall contain no analytes at or above the minimum detection limits for any constituents of interest.

Table 6.6-1. Reagent/Standards Storage

Type		Storage
<u>Cleaning Reagents</u>		
Alconox	Powder	Dry, clean, controlled room temperature (15 to 30°C), and devoid of other chemicals.
Liquinox	Liquid	
Hexane	Reagent grade	
Deionized water	Reagent grade	
Analyte-free water	Reagent grade	
<u>Calibration/Buffer Reagents</u>		
pH	4, 7, 10 solutions	Dry, clean, controlled room temperature (15-30°C), devoid of chemicals; all reagents of this nature will be stored separately from any sources of contamination Stored separately in clean, dry (15 to 30°C) area.
Conductivity	200, 2,000 μ mho/cm,	

Note: μ mho/cm = micromho per centimeter.

As discussed in Section 6.2, organic-free water is utilized during field decontamination and for the preparation of field equipment blanks (Section 6.1). The integrity of supplied organic-free water is questionable when equipment blank results provide evidence of contamination. Such incidences will be recorded to monitor the organic-free water provided to ECT.

7.0 SAMPLE CUSTODY

7.1 FIELD SAMPLE CONTROL OPERATIONS

Chain of custody of samples begins when clean sample bottles are picked up from the laboratory. Each sample container is identified by a unique number located on the sample label. Properly labeled samples remain in the custody of the field sampling technician until they are relinquished for transport to the laboratory. Sample chain of custody forms are supplied by the laboratory. A copy of the chain of custody will remain on file under each project number in the custody of the project manager.

The primary objective of sample custody is to create an accurate written verified record, which can be used to trace the possession and handling of the sample containers from the moment of receipt until returned by the laboratory. Sample custody will be archived by approved field and laboratory documentation.

A sample for this project is defined to be in someone's custody if:

1. It is in one's actual physical possession;
2. It is in one's view, after being in one's physical possession;
3. It is in one's physical possession and then locked or otherwise sealed so that tampering will be evident; or
4. It is kept in a secure area, restricted to authorized personnel only.

Field procedures will be designed to minimize sample handling and transfers. During sampling, the field crews will record the following information in field notebooks using indelible ink;

1. The unique sample number as obtained from the sample label and parameters to be analyzed;

2. Source of sample (including designation, name, location, and matrix type);
3. Description of sampling points (i.e., monitor well, number, boring, key landmarks, etc.);
4. Date and time of sample collection;
5. Order of sample collection;
6. Preservatives used;
7. Name(s) of collector(s);
8. Field data (pH, temperature, and specific conductance and site conditions);
9. Sampling equipment (i.e., purge method, bailer type, etc.); and
10. Types of quality assurance samples collected (i.e., field blanks, equipment blanks, split, etc.);

ECT field personnel are responsible for **uniquely** identifying and labeling each sampling point. This identification should be logged onto all field forms, chain of custody, and into field logbooks. It will not be permissible to change the sampling point identification once it has been established. All sample collection activities will be traceable by field records, sample collector, chain of custody documents, and a database if available. **Errors made in original field documentation must be shown with a single line drawn through and initialed by ECT personnel.**

7.2 SAMPLE TRANSPORT

Samples collected during field investigations will be transported by field personnel in a suitable way to preserve their integrity. Those samples which require a lower temperature for preservation will be placed inside an insulated cooler of wet ice. All reusable ice chests will be washed inside and out with Alconox, rinsed with tap

water, and air dried if suspect contamination occurs in field situation. Should any sample kit require a commercial carrier, chain of custody records will specify to whom, where, and when the sample kits were relinquished. The container will remain sealed with custody tape during transport.

8.0 ANALYTICAL PROCEDURES

8.1 FIELD METHODS

Table 8.1-1 includes field measurements and corresponding procedure reference methods as performed by ECT personnel:

Table 8.1-1

Field Parameter	Reference Method
pH	EPA Method 150.1
Specific conductance	EPA Method 120.1
Temperature	EPA Method 170.1

9.0 CALIBRATION CONTROLS AND FREQUENCY

9.1 FIELD MEASUREMENT EQUIPMENT

All field equipment will be calibrated immediately prior to use in the field. The calibration procedures will follow standard manufacturer's instructions or routine ECT procedures to assure that the equipment is functioning within tolerances established by the manufacturer and required by the project. Field personnel will document all instrument calibrations in bound field notebooks and on specific calibration forms. All records generated will be maintained by field personnel and are subject to audit by the ECT QA Manager.

The detailed calibration, operation, and maintenance procedures for field instrumentation routinely used by ECT personnel are specific to manufacturer's instructions. The following sections will briefly summarize these procedures. Table 9.1-1 lists all field instruments, calibration frequency, and calibration standards.

9.2 CALIBRATION STANDARD RECEIPT AND TRACEABILITY

Calibration standards and pH buffer solutions used for field instrumentation calibration checks will be obtained from scientific products supply companies (e.g., Fisher Scientific; American Scientific Products, etc.). All buffer and calibration standards obtained will be certified and standardized against or traceable to National Institute of Standards and Technology (NIST) reference materials through the specific products supply company. All solutions are stored according to manufacturer's suggestion for optimal shelf-life. Stock solutions will be marked with expiration date and replaced with new solutions when the recommended shelf-life is exceeded. Figure 9.2-1 is an example of the standard solutions log used to monitor all buffer and calibration standards.

Table 9.1-1. Field Instrumentation, Calibration Frequency, and Calibration Standards

Field Instrument(s)	Measurement Parameter	Environmental Matrix	Calibration Frequency	Calibration Standards
Corning Checkmate M90/ Hydrolab Surveyor II	pH	Water	Daily	pH 4, 7, 10 **
	Temperature	Water	Daily	NIST grade thermometer
	Dissolved Oxygen	Water	Daily	Na ₂ SO ₃ Zero Oxygen Solution **, air 10mm above water
	Specific Conductance	Water	Daily	75, 200, 720, 2000 μ mho **

Note: (1) Calibration of field instruments will occur on a daily basis when the instruments are in use.
 (2) Water may be defined as groundwater, surface water, wastewater, drinking water, etc.
 ** Commercially available calibration standards.

[illegible]

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9.3 pH METER

Calibration is performed at the start of each sampling day using two (2) National Institute for Standards and Technology (NIST) traceable standard solutions which bracket the pH range expected in the samples. Calibration knobs are used to set the meter to read the value of the standard. The meter is then checked during the sampling period, using at least one standard which results in little or no calibration adjustment. If the reading varies more than one-tenth of a unit between calibration checks, the frequency of the checks must be increased.

9.4 CONDUCTIVITY METER

Calibration is performed at the start of each sampling day using potassium chloride (KCl) standard solutions prior to each field trip. Specific conductance standards are selected to bracket the range of values expected in the samples. If the unit has a calibration adjustment, the meter is calibrated in the same manner as the pH meter. Internal automatic adjustments are made on meters which lack a designated calibration knob. The meter must read within 10 percent of the standard to be considered in control and should read within 5 percent (7 percent considered a warning level) to be acceptable.

If the calibration indicates the meter is out of control, a backup unit should be employed; if one is not available, the data will be flagged to note the percent difference between the meter and standard. Readings from conductivity meters lacking calibration adjustments are limited to checks at the beginning and end of the sampling day. All calibrations may be recorded on a multicalibration log sheet, Figure 9.4-1, along with conclusions as to the acceptability of readings.

ECT MULTI-PARAMETER CALIBRATION LOG

Client:

Location:

Cal. Time:

[illegible]

Date:

Date:

14:15

03-Jun-91

G-MST11\ECTLOGS\MULTICAL

FIGURE 9.4-1.
MULTI-PARAMETER CALIBRATION LOG
CARIBE GENERAL ELECTRIC PRODUCTS, INC.
SAN GERMAN, PUERTO RICO
JUNE 1992

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9.5 TEMPERATURE METER

Temperature is measured using a thermistor built into the Yellow Springs Instrument Model 33. The readings will be checked at least once per field trip using a NIST quality grade thermometer.

The calibration frequencies noted above are the minimum requirements. Additional checks should be performed if the unit experiences harsh conditions or if readings become erratic.

9.6 CALIBRATION FORMS AND RECORD KEEPING

All calibrations will be recorded in a field notebook and on standard field calibration forms. These calibration forms become part of the individual project files as documentation of QA objectives. Section 11.0 describes in detail the handling of field data including retrieval, storage, and reporting.

10.0 PREVENTATIVE MAINTENANCE

10.1 ROUTINE MAINTENANCE

ECT personnel routinely maintain field equipment for optimal results. Any field activities involving routine maintenance will be recorded in field logbooks by the individual performing the adjustment of the equipment. Table 10.1-1 represents an outline of routine procedures performed on ECT instrumentation.

10.2 CONTINGENCY

The Task Managers maintain all documentation concerning routine maintenance and non-routine repairs. All pertinent information regarding instrument status is recorded in ECT personnel field log books along with calibration documentation. Figure 10.1-1 includes an example of ECT preventative maintenance documentation.

10.3 CONTINGENCY

in the event that the primary ECT field equipment is inoperable as determined by calibration difficulties, back-up field instruments will be obtained from other sources. These instruments will be calibrated prior to recording data. In no event shall instruments be used to record data unless the performance of the equipment has been documented.

Table 10.1-1. Routine Maintenance Activities for Field Equipment

Instrument/Equipment	Specific Activity	Frequency
Conductivity Meter	Check instrument probe for damage, residue, or film buildup.	Before each use
	Rinse probe with deionized water.	After each use
pH meters, selective ion meters and electrodes	Rinse electrode well after each reading with deionized water.	After each use
	Maintain electrode immersion in solution.	During non-use
	Examine/clean electrode surface.	Daily
Temperature Meter	Cross check with a calibrated NIST certified thermometer.	Before each use

[illegible]

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11.0 QUALITY CONTROL CHECKS, ROUTINES TO ASSESS PRECISION AND ACCURACY AND CALCULATION OF METHOD DETECTION LIMITS

During independent sampling events, variable quality control functions will occur. Previous sections discuss proper procedures to assure sample integrity through the prevention of cross contamination. ECT has implemented field quality control requirements (Table 11.0-1) for minimum standards in field quality control. The various types of quality control samples, equipment, field, and travel blanks as defined in Section 11.1, are designed to measure:

1. The integrity of sample container and sample equipment cleaning;
2. The actual sample collection process;
3. Purity of sample preservative or additive reagents;
4. The influence of site environmental conditions (i.e. excess contamination);
5. Cross contamination of samples; and
6. Indeterminate artifacts introduced during the transport of samples, sample and shipping containers, cleaning agents and sampling equipment.

All field quality control blanks will be preserved, documented, and transported in the same manner as the collected samples. The information obtained from the laboratory analyses will serve to expose the potential source of impurity. The following paragraphs describe equipment, field, and travel blank collection frequency.

Table 11.0-1. Minimum Field Quality Control Requirements

Field QC activities must meet or exceed the following criteria:

I. QC Checks to be submitted for laboratory analysis:

Precleaned equipment blank: Analyte-free water blank of equipment rinsate performed onsite before sampling begins.

Field cleaned equipment blank: Analyte-free water blank of equipment rinsate performed onsite after equipment has been cleaned in the field (between sampling points).

Trip blank: Analyte-free water blank (VOCs only) prepared when sample containers are prepared, transported to the field, and handled in the same manner as the samples.

# of Samples	Precleaned Equipment BLK	Field Cleaned Equipment BLK	Trip BLK (VOCs)	Duplicates
10+	Minimum of one, then 5 percent	Minimum of one, then 5 percent	One per cooler	Minimum of one, then 10 percent
5 to 9	One*	One*	NR	One
1 to 4	One*	One*	NR	NR

Note: NR = Not required.

BLK = Blank.

- * For 10 or less samples, precleaned equipment blanks or field cleaned equipment blanks are required (field cleaned blanks are required if equipment is cleaned in the field).

II. Quality Control Checks on Field Measurements:

Duplicates: For precision, at least one duplicate sample analyzed for every 10 field measurements (consecutive and cumulative).

QC Check Standards: For accuracy, QC check standards (different source and/or value than calibration standards) analyzed at a frequency of 5 percent is recommended.

Source: ECT Comprehensive Quality Assurance Plan, Revision 0, March 5, 1991.

11.1 FIELD QUALITY CONTROL CHECKS

11.1.1 DUPLICATE SAMPLES

Sampling events involving five or more samples will include the collection of at least one duplicate sample or 10% of the samples, whichever is greater. A duplicate sample will include all parameter groups and matrices to be analyzed according to the project plan.

11.1.2 EQUIPMENT BLANKS

Equipment blanks are prepared according to the following procedure:

1. Document equipment, date, time, and sample location in field logbook and chain of custody. Designated as field decontamination equipment blank or dedicated (pre-cleaned) equipment blank.
2. Fill or rinse equipment with analyte-free water.
3. Pour directly into sample containers as provided for each parameter group of interest. Repeat as necessary.
 - A. Sampling Events Involving Ten or More Samples of Similar Matrix--The equipment blank is designed to address cross contamination in the field between sample sources due to deficient field cleaning procedures. This blank also addresses lab preservation procedures, environmental site interference, integrity of the source blank water for field cleaning and those concerns singularly addressed by the travel blank.

There is *at least one* equipment blank submitted and analyzed on precleaned sampling equipment for every 20 samples in each parameter group (which includes all matrices). This equipment blank will be composed in the field before sampling begins by filling or rinsing the precleaned equipment (i.e., bailer, pump tubing, spoon, etc.) with analyte free water, filling the designated blank containers, preserving and documenting in the exact manner as the collected samples.

An equipment blank will be prepared for each parameter group sampled where a particular piece of sampling equipment was employed for sample collection. Equipment that is cleaned onsite requires additional equipment blanks to be collected and analyzed for each parameter group at a rate of one blank or five percent of the equipment sets that are cleaned, whichever is greater. These blanks shall be collected and analyzed for all types of matrices.

- B. Sampling Events Involving Less Than Ten Samples of Similar Matrix--One equipment blank shall be collected and analyzed for each parameter group of either field decontaminated or precleaned equipment.

11.1.3 TRAVEL (TRIP) BLANK

The travel blank is designed to address interferences derived from improper sample container cleaning preparation, contaminated source blank water, sample cross contamination during storage/transport, and extraneous environmental conditions affecting the sampling event to and from the site, including delivery to the analytical laboratory. Travel blanks are required for volatile organic method analyses at a rate of one per transport cooler per day when ten or greater samples are submitted.

Travel blanks are composed by the laboratory in the appropriate sample container using source blank water. Preservatives are added if required for that parameter group. Travel blanks are then sealed and stored in the ice chest where real samples will be stored and transported. Travel blanks are to originate at the facility (i.e., laboratory) providing the blank water for the equipment and field blanks.

11.1.4 BLANKS FOR NON-AQUEOUS SAMPLES

Field collected blanks for sediment, solid and other types of nonaqueous samples are necessary. For these sample types the following blanks are required:

1. Trip blanks in the same frequency as water samples for volatile organic method groups only.

2. Equipment blanks using the same criteria and frequency as those for water samples. The collected blanks will be analyzed using appropriate water analysis methods.
3. Duplicates using same criteria and frequency of one or 10 percent, whichever is greater.

Any analytes of interest detected in the equipment blank must be reason for concern as the results indicate that the equipment was improperly decontaminated prior to the collection of the equipment blank. The QA Manager must make a judgement as to the validity of the results based on the level of contamination in the blank as well as the levels of analytes detected in the samples.

11.2 ROUTINE METHODS USED TO ASSESS PRECISION AND ACCURACY

At least one or ten percent of field measurements will be duplicated using the same instrument. The results will be recorded to calculate the precision of equipment used. Any instrumentation that does not perform in a sufficient manner will be eliminated from sampling events, therefore a backup unit should be utilized.

The accuracy of field instruments is also obtained from field data on a five percent basis (one out of every 20 field measurements). Accuracy may be obtained by determining the percent recovery of a "known" standard at the completion of sampling event. The percent recovery value allows the monitoring of field instrument reliability. Instruments that display a significant percent recovery loss will be inspected and serviced accordingly.

Precision and accuracy charts will be updated every twenty data points or annually, whichever comes first. The QA Manager will be responsible for the generation of these data and to suggest actions in the occurrence of out of control limits.

11.2.1 PRECISION

Precision is a measure of the ability to reproduce the result of a measurement using the same test procedure. Precision is assessed for applicable parameters by calculating the relative percent difference (RPD) of samples analyzed in duplicate. Representative samples will constitute the entire range of concentrations encountered for statistically meaningful data, thus data generated from RPD equations will be in terms of concentrations ranges.

Concentration ranges are divided into three categories. Low level ranges are concentration ranges from the method detection limit (MDL) to a level five times the MDL. Mid level ranges are considered the mean between the MDL and the upper end of the concentration range. High level ranges are those concentrations at the upper control limit. This division of concentration ranges is used to present data in relative terms and subject to change.

$$RPD = \frac{(S_1 - S_2)}{(S_1 + S_2) / 2} \times 100$$

where:

RPD = Relative Percent Difference

S_1 = Original Sample

S_2 = Duplicate Sample

$$\text{Average RPD} = \frac{RPD_1 + RPD_2 + RPD_n}{N}$$

where: N = Number of Replicate Samples

Estimates of precision for sampling parameters are not meaningful statistically unless the number of data points is ten (10) or more. Therefore, using data generated from ECT sources, twenty (20) data points were used in calculating the average RPD value mentioned in Section 5.0. The values given in Section 5.0 are precision objectives which represent the upper control limit for field analyses.

11.2.2 ACCURACY

Accuracy is the degree of agreement between a sample's target value (a known concentration) and the observed or measured value. Accuracy for field measurements (i.e., pH and conductivity) is measured by calculating the percent recovery (% R) of known standard solutions. Percent recovery is calculated as follows:

$$\%R = \frac{\text{observed (measured) value}}{\text{true value}} \times 100$$

Each calculated PR value is compared to the accuracy criteria listed in Section 5.0. The accuracy ranges provided in Section 5.0 are based on the mean accuracy measured for each parameter (based on ECT data) plus or minus three standard deviations of the mean.

11.2.3 COMPLETENESS

Completeness is defined by EPA "as a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions" (EPA, 1980). A completeness of at least 90 percent for each field parameter measured is the objective ECT projects. Following completion of the testing, percent completeness will be calculated as follows:

Completeness (%) for n =

$$\frac{\text{number of valid } n \text{ values reported}}{\text{number of samples collected for analysis of } n} \times 100$$

If completeness is less than 90 percent for any parameter(s), the project manager will be notified immediately. The project manager is responsible for determining if resampling will be necessary to meet project objectives and will inform the QA Manager of his/her decision.

11.2.4 QUALITY CONTROL CHARTS

Quality control charts will provide a graphical model to represent statistical control in quality assurance. A control chart imposes limits of measured values such as control limits (3-sigma) and warning limits (2-sigma) within which 95 percent of the reported values exist.

Field measurement equipment will be monitored per parameter via control charts. Such quality control charts will be updated with the addition of twenty (20) new data points or annually, whichever comes first. Control charts will be made available to all field personnel and will be maintained by the QA Manager.

12.0 DATA REDUCTION, VALIDATION, AND REPORTING

12.1 DATA REDUCTION

Field measurement data collected during the project investigation tasks are recorded in bound field logbooks which identify the project, sample records/parameters and date. Data obtained through field measurements are examined against the data quality objective guidelines for each instrument.

For all field sampling parameters the data acquired is that which is directly read from the instrument. The following reporting units will be used during all phases of the project:

- pH will be reported to 0.1 standard unit.
- Specific conductance will be reported to two significant figures below 100 μ mhos/cm and three significant figures above 100 μ mhos/cm.
- Temperature will be reported to the nearest 0.5° celsius.
- Water levels measured in wells will be reported to the nearest 0.01 ft. Water levels measured in open borings will be reported to the nearest 0.5 ft.
- Soil sampling depths will be reported to the nearest 0.5 ft.

Field measurements will be made by competent field geologists and engineers, environmental analysts, and technicians. Field data collected during the project investigation tasks will be identified and reported to the project manager for weekly validation. Pertinent field measurement data used in preparing project reports (i.e., well boring logs) will be included in appropriate appendices with the project reports.

12.2 DATA VALIDATION

Validation of field data will be performed by the ECT Project Manager. Four different procedures will be used to validate data:

1. Routine checks will be made during the processing of data. An example is looking for errors in identifying codes (e.g., time of sampling, location of sample, method of sampling, etc.).
2. Internal consistency of a data set will be evaluated. This step may involve plotting the data into control charts and evaluating trends.
3. Checks for consistency of the data set over time will be performed. This can be accomplished by visually comparing data sets against gross upper limits obtained from historical data sets. Anomalous data will be identified.
4. Checks may be made for consistency with parallel data sets, i.e., data sets obtained presumably from the same population (e.g., from the same region of the aquifer or volume of soil).

The purpose of these validation checks and tests is to identify outliers; that is, an observation that does not conform to the pattern established by other observations. Outliers may be the result of transcription errors or instrumental breakdowns. Outliers may also be manifestations of a greater degree of spatial or temporal variability for the environmental samples than expected.

After an outlier has been identified, a decision concerning its fate must be rendered. Obvious mistakes in data will be corrected when possible, and the correct value will be inserted. If the correct value cannot be obtained, the data may be excluded. An attempt will be made to explain the existence of the outlier. If no plausible explanation can be found for the outlier, it may be excluded, but a note to that effect will be included in the report. Also, an attempt will be made to determine the effect of the outlier when both included in and excluded from the data set.

Document control includes the maintenance of project files traceable by project number. All project files will be uniquely identified and maintained by the project manager. Project personnel may keep their own files; however, all official and original documents will be placed in the official project file.

Figure 12.2-1 is a flow chart showing the handling of field data from retrieval to storage.

12.3 DATA REPORTING

Raw data will be collected, reviewed and entered into the reporting system by technical staff. A preliminary report is compiled by the project manager and reviewed for accuracy, completeness, and compliance with our Quality Assurance Program. Figure 12.3-1 is an example of ECT's document review sheet which provides a checklist for review purposes and for document control.

After the preliminary report has been reviewed, the final report is generated. This final report will be placed in a project specific master file and a final evaluation by the project director will precede the submission of report to client/regulatory agency.

12.4 DATA STORAGE

ECT will retain a hard copy of the final report in the project specific master file and all project files will be maintained by the project manager. The file will contain all original and official documents pertinent to the specific project. As added insurance, ECT's data processing department shall retain computer disks of all archived documents indexed by document, date, and client. A backup system for the computer disk storage has been implemented for the assurance of data integrity.

All data is at a minimum stored under office security measures and held for a period greater than five years. This data is readily accessible using any of the following ranges: ECT project number, date of document, client and document title.

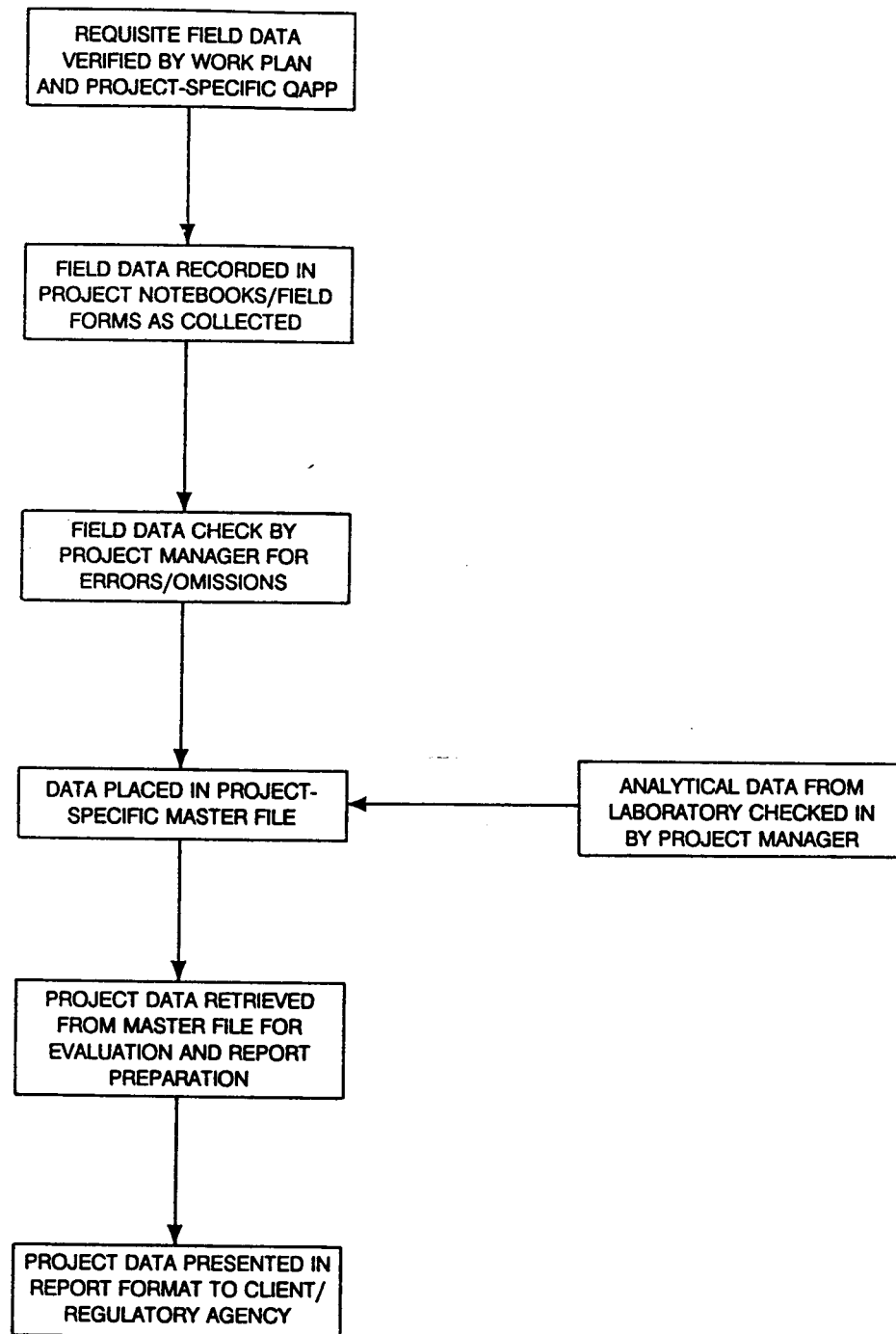


FIGURE 12.2-1.
FLOW CHART OF ECT DATA RETRIEVAL AND
STORAGE SYSTEM
CARIBE GENERAL ELECTRIC PRODUCTS, INC.
SAN GERMAN, PUERTO RICO
Source: ECT, 1992.

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DOCUMENT REVIEW SHEET

SHORT TITLE: _____

CLIENT: _____

PROPOSAL/PROJECT NO.: _____

DATE/TIME TO LEAVE ECT: _____

PROPOSAL/PROJECT MANAGER: _____

CLIENT DUE DATE: _____

AUTHOR(S): _____

DOCUMENT COORDINATOR: _____

REVIEW CHECKLIST

(Check Reviewed Categories)		1		2		3		4		5		6		7		8	
		D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F
Reviewer	Document/Section(s)																

APPROVALS: _____ (As appropriate)

AUDITED: _____ (QA Manager or Designate)

REMARKS: _____

- 1- Organization/Presentation Reviewed
- 2- Technical Approach and Conclusions Reviewed
- 3- Table, Figure, Text Data Checked
- 4- Critical Calculations Checked

- 5- Laboratory Data Checked (if applicable)
- 6- Field Measurements Checked
- 7- Proposal Costs Reviewed (if applicable)
- 8- Computer Models/Programs Calibrated and Verified

Original to PROJECT MANAGER—Copy to QA MANAGER

FIGURE 12.3-1.
DOCUMENT REVIEW SHEET
CARIBE GENERAL ELECTRIC PRODUCTS, INC.
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Source: ECT, 1992.



13.0 CORRECTIVE ACTION

13.1 FIELD PROCEDURES

When quality control criteria for field procedures indicate an analysis is out of control, corrective actions will be implemented. ECT quality control criteria levels are addressed in Section 11.0 of this plan. The corrective actions commonly encountered are represented in Table 13.1-1.

ECT management personnel auditing field procedures will discuss discrepancies with the individual and instruct him or her on correct procedures. Subsequently, management personnel will document the discrepancy, instruct corrective action and then forward this information to the QA Manager.

Corrective actions for field sampling procedures in which field audits have indicated a procedural variance from the project work plan, or this QAP will be monitored by project manager and/or QA Manager. Corrective action includes, but is not limited to:

1. Instrument will not be utilized during sampling event.
2. Isolate the potential source(s) of contamination.
3. Immediately correct the problem.

In the event reconciliation of instrument operation under acceptable criteria standards is not achieved, then back up instrumentation will be implemented only after passing the initial acceptable criteria.

Table 13.1-1. Corrective Actions

QC Activity	Acceptance Criteria	Recommended Corrective Action
Initial Calibration Standards	Standard concentration value 10% of the expected value	Reanalyze; if still unacceptable use standard from another stock solution. Second, perform maintenance check.
QC Check Standards	The end of sampling events readings should be 10% of the initial reading	Recalibrate using stock standards; note the discrepancy
Duplicate Samples	Laboratory analysis should agree within 10% of each other.	Notify lab of disagreement, and prepare a split sample with another lab to check variability. Second, field personnel should be observed for precision in duplicating sample event, and possibly retrained.
Equipment Blanks	Laboratory analysis establishes non-detectable concentrations.	Notify lab and/or field personnel of improper cleaning procedure - seek cause, establish in written report.
Trip Blanks	Laboratory analysis establishes non-detectable concentrations.	Determine cause/origin of contaminate; establish in written report.

14.0 SYSTEMS AUDITS

ECT QA personnel will perform system audits to assess and document performance of project staff. These audits are performed at frequent intervals under the direction of the QA Manager. Audits form one of the bases for corrective action requirements and constitute a permanent record of the conformance of measurement systems to the ECT QAP.

System audits are inspections of training status, records, QC data, calibrations, and conformance to standard operating procedures without the analysis of check samples. System audits will be performed periodically on office, and field operations.

The system audit protocol is summarized as follows:

1. Field Operations--The QA Manager will conduct an unannounced field audit during the course of the field activities (quarterly) to check:
 - a. Field notebooks, sample custody tracking forms, and report any inconsistencies and/or omissions;
 - b. Field sampling plans and project-specific QAPs;
 - c. Sample site briefing package;
 - d. Field equipment calibration procedures; and
 - e. Field sampling techniques.

An example field performance checklist is contained in Figure 14.0-1.

2. Office Operations--The QA Manager will check office project activities and record keeping by conducting an unannounced audit (quarterly) on 10 percent of the active project files to check:
 - a. Field data archived in project files on appropriate field forms, including record of field equipment calibration;
 - b. Field data checked-off by Project Manager for errors/omissions;

FIELD PERFORMANCE AUDIT CHECKLIST

FORM NO.: FPAC-1
REV. NO.: 1
DATE: 10/10/89

PROJECT: _____ PROJECT #: _____

PROJECT DESCRIPTION: _____

PROJ. MANAGER: _____ OFFICE: _____ CLIENT: _____

ACTIVITY	YES	NO	N/A	CORRECTIVE ACTION
PRE-FIELD WORK PLANNING PHASE				
Project-specific QAPP submitted?				
Field team meeting conducted?				
Field work plan & map available?				
Necessary permits obtained?				
Client/FDER notified of schedule?				
Field equip. operational & calib.?				
Lab-supplied sample kits checked?				
Chain-of-custody initiated?				
FIELD EQUIPMENT CALIBRATION PHASE				
Types of meters to be used?				
Field equip. calib. @ beg/mid/end?				
Frequency of equip. calibration?				
Equip. calib. data rec. on forms?				
Calib. standards NBS traceable?				
Calib. Stds. w/in rec. shelf-life?				
Manuf. calib. proced. adhered to?				
Stds. bracketed expected range?				
SAMPLE BLANKS PHASE				
Blanks taken (field/trip/equip.)?				
Sample blanks cont. & preserv. app.?				
Sample blanks COC forms completed?				
Sample blanks iced in the field?				

AUDITOR Signature: _____ Date: _____

FIGURE 14.0-1.
FIELD PERFORMANCE AUDIT CHECKLIST (PAGE 1 OF 4)
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FIELD PERFORMANCE AUDIT CHECKLIST

ACTIVITY	YES	NO	N/A	CORRECTIVE ACTION
FIELD COLLECTION--SURFACE WATER & SEDIMENT				
Equip. decon'd. acc. to work plan?				
Sampling sta. located acc. to plan?				
Sampling collection station order?				
Downstream samples collected first?				
Samples collected midstream?				
Samples taken upstream from bridges?				
Care exercised not to stir up sed.?				
Gloves worn/changed after samp. coll.?				
Were preservatives added in field?				
Field parameters rec. on app. form?				
Containers & preserv. acc. to plan?				
Sample desc. & loc. on COC form?				
Samples iced in field in cooler?				
FIELD COLLECTION--SOILS				
Types of sampling equip. used?				
Equip. decon'd. acc. to work plan?				
OVA calib. prior to HS gas meas.?				
Pert. observ. rec. on field form?				
Containers & preserv. acc. to plan?				
Sample desc. & loc. on COC form?				
Samples iced in field in cooler?				

AUDITOR Signature: _____ Date: _____

FIGURE 14.0-1.
FIELD PERFORMANCE AUDIT CHECKLIST (PAGE 2 OF 4)
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CE-SC000007

FIELD PERFORMANCE CHECK LIST

ACTIVITY	YES	NO	N/A	CORRECTIVE ACTION
FIELD COLLECTION--GROUNDWATER				
Site map with well loc. available?				
Req. time elapsed since well dev.?				
Water level meas. taken & rec.?				
Water level tapes decon'd?				
Well purge volume determined?				
Req. # of bails taken per well vol.?				
Was foil/plastic placed around well?				
Were any fuel powered units used?				
Were fueled units downwind of well?				
Were fueled units used for sampling?				
Were dedicated bailer used?				
Were bailers decon'd acc. to QA plan?				
Was nylon rope used?				
Did nylon rope touch the ground?				
Was rope discarded after use?				
Gloves worn/changed while sampling?				
Gloves worn/changed while deconing?				
Equip. decon'd. acc. to work plan?				
Decon/rinse water properly disposed?				
Containers & preserv. acc. to plan?				
Sample desc. & loc. on COC form?				
Samples iced in field in cooler?				

AUDITOR Signature: _____ Date: _____

FIGURE 14.0-1.
FIELD PERFORMANCE AUDIT CHECKLIST (PAGE 3 OF 4)
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FIELD PERFORMANCE CHECKLIST

ACTIVITY	YES	NO	N/A	CORRECTIVE ACTION
SAMPLE SHIPPING/DELIVERY TO LABORATORY PHASE				
Verified completion of field forms?				
COCs completed & placed w/samples?				
Coolers sealed with COC strips?				
Samples shipped overnight to lab?				
Samples shipped acc. to FDOT regs.?				
Phone verif. of lab rcv. samples?				
RECORDS KEEPING AND DATA REPORTING PHASE				
Field form copies in project file?				
Field notes taken and complete?				
Field book notes copied to file?				
Field data forms chck'd by PM?				
QA forms in QA Supervisor file?				
COC sample forms in project file?				
Lab analytical data rpts. in files?				
COMMENTS				

AUDITOR Signature: _____ Date: _____

FIGURE 14.0-1.
FIELD PERFORMANCE AUDIT CHECKLIST (PAGE 4 OF 4)
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Source: ECT, 1992.

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- c. Laboratory data and chain-of-custody forms archived in project files; and
- d. Record of draft report review and sign-off by independent technically-qualified personnel.

Each office QA Manager will provide ECT's QA Officer with the results of the systems audits performed by each office during each quarter. The QA Officer will be responsible for reviewing these audit documents and preparing a summary report to the Corporate Officers. Any QA deficiencies identified and corrective actions implemented by the QA Managers will be evaluated by the ECT QA Officer and reported to the Corporate Officers for further action (if necessary).

15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

ECT's QA Manager will prepare routine internal QA reports on a quarterly basis for review by the QA Officer, Project Managers, and Departmental Managers, and clients (if they so request). The reports will contain, at a minimum:

- A periodic assessment of field measurement data accuracy and precision,
- Results of system audits,
- Significant QA/QC problems and recommended solutions, and
- Outcome of any corrective actions.

These QA reports will present the results of the systems audits, significant QA/QC problems and corrective actions, and status of corrective actions.

16.0 RESUMES

Resumes of key personnel are attached.

TIMOTHY F. CAUGHEY, C.I.H., M.P.H.
MANAGER, INDUSTRIAL HYGIENE/ASBESTOS

Areas of Specialization

Industrial Hygiene, Asbestos Management, Toxicology, Hazardous Waste Site Health/Safety, Regulatory Compliance Audits, and Indoor Air Quality

General Experience

Department Manager, Hazard Evaluation and Remediation, Environmental Consulting & Technology, Inc. (ECT), 1990-present.

Department Manager, Industrial Hygiene/Asbestos, Environmental Science and Engineering, Tampa, Florida, 1989-1990.

Corporate Industrial Hygienist, Jim Walter Corporation, Tampa, Florida 1987-1989.

Senior Industrial Hygienist, State of Florida, Department of Labor, 1978-1987.

Relevant Project Experience

Project Manager; Edward J. DeBartolo Corporation--Responsibilities included project asbestos management and coordination of plans and specifications, facility surveys, air monitoring, and abatement reports for DeBartolo malls.

Project Manager; Polk County School Board--Developed plans and specifications for over 10 abatement projects, supervised all project management, and developed final reports.

Project Manager; Celotex Corporation--Performed evaluation and developed control measures for employee exposure to methylene diphenyl diisocyanate (MDI), and Trichlorodifluoromethane (R-11) in 5 rigid foam insulation manufacturing plants.

Project Manager; United Concrete Pipe--Conducted air monitoring for respirable free silica and provided training for hazard communications and hearing conservation.

Project Manager; Jim Walter Corporation--Developed and implemented a corporate wide noise assessment and hearing conservation program.

Project Manager; J.W. Aluminum--Conducted an industrial hygiene audit for large aluminum processing and fabrication facility. Performed air sampling for aluminum oxides, ozone, refractory fibers, and airborne particulates.

Project Manager; Imperial Lakes Country Club--Performed pre-development survey to determine presence of radon, recommended building techniques, and remediation plan. Used gamma scintillator and alpha track soil probes.

TIMOTHY F. CAUGHEY, C.I.H., M.P.H.

Project Manager; Anchor Investments--Performed community noise assessment for client to determine if future development would be in compliance with existing community noise guidelines.

Project Manager; General Electric Neutron Device Facility--Performed asbestos survey, hazard assessment, developed plans and specifications, and supervised abatement of asbestos containing materials in this top security Department of Energy facility.

Project Manager; Slöss Industries--Performed Occupational Health Audit and evaluated employee exposure to airborne mineral wool fibers for world's largest producer of mineral wool. Characterized fibers as to concentration (NIOSH 582), aerodynamic diameter, total and respirable dust.

Project Manager; Gainesville Regional Utilities--Performed indoor air quality survey to determine source of irritation to building occupants. Included chemical and microbial sampling.

Project Manager; City of Clearwater--Developed an indoor air quality index for five libraries so indoor air quality could be compared to outdoor air quality, and between buildings; recommended guidelines.

Project Manager; Cherokee Brick--Conducted industrial hygiene surveys for 5 large brick manufacturing plants. Performed air sampling for respirable free silica, total dust and noise exposure.

Project Manager; Pinellas County School Board--Developed plans and specifications for five abatement projects and supervised all project management and supervision.

Project Manager; Lead Based Paint, Polk County School Board, Bartow, FL--Developed lead paint specifications for Polk County School Board for lead paint abatement activities.

Task Manager; Environmental Audit, Lead Base Paint, Confidential Client--Responsibilities included the performance of lead paint surveys for various environmental audits pertaining to Department of Housing and Urban Development (HUD) loans.

Task Manager; Highway Department, Pasco County, FL--Responsibilities included the performance of lead paint air monitoring during highway painting operations.

Task Manager; State of Florida, Confidential Client--Performed an industrial hygiene survey/lead paint evaluation for a large auto painting operation.

Task Manager; Birmingham, Alabama; U.S. Pipe and Foundry--Responsibilities included the evaluation and subsequent control of airborne lead dust for seven foundries.

TIMOTHY F. CAUGHEY, C.I.H., M.P.H.

Education

B.S.	Pre-Med Biology	St. Francis College	1978
M.P.H.	Industrial Hygiene	University of South Florida	1986

Registrations

Certified Industrial Hygienist, #3717
Licensed Asbestos Consultant, #IA0000016
Certified Hazardous Materials Manager, #798
Certified Audiometric Technician
AHERA Asbestos Abatement Supervisor
AHERA Facility Survey and Building Systems
AHERA Management Planning
OSHA 40 Hour Hazardous Waste Site Training

GARY P. UEBELHOER
SENIOR PROJECT MANAGER

Areas of Specialization

Environmental Impact Statements and Assessments, Permitting, Development of Regional Impact Studies, Community Affairs and Land Management, Air Quality, Surface Mining, Waste Disposal Planning, and Land Reclamation/Restoration

General Experience

Vice President of Environmental and Administrative Affairs, AMAX Chemical Corporation, 1984-1986.

Vice President of Public Affairs, AMAX, 1983-1984.

Director of Environmental Affairs, AMAX, 1980-1983.

Environmental Project Manager, AMAX, 1976-1980.

Relevant Project Experience

Environmental Project Manager; Third Party EIS for Surface Mine for AMAX-- Managed company role in joint EPA-COE third party EIS for surface mine. Instituted baseline multidiscipline assessment; designed and managed pilot-scale residuals management study to document process waste characteristics; managed pump tests and analysis in support of 15 MGD consumptive water permit; developed comprehensive discussion of company's proposed action and analysis of alternatives; worked with community leaders and public to explain the project's scope and descriptions; and conducted pilot scale natural systems revegetation studies.

Environmental Project Manager; Environmental Assessment and Permitting for Expansion of Surface Mine-- Permitted on a timely basis the expansion of a surface mine at less than budget cost and ahead of schedule including ADA/DRI, master mining and reclamation plan revision, PSD analysis, and consumptive water use permits.

Project Manager; EIA/EIS for Copper-Nickel Mine and Associated Facilities for AMAX-- Responsible for environmental activities associated with EIA/EIS for 30,000 tons per day project. Prepared description of the proposed action, prepared socioeconomic analysis concerning project economics and demands on Minnesota infrastructure, and assisted in design and analysis of field leaching tests on site and at Twin Buttes mine near Tucson, AZ.

Environmental Affairs Director for Major Mining Operation-- Performed environmental compliance audits on newly acquired surface mine and plants. Developed computerized monitoring system which ensured compliance with environmental permits and alleviated previous legal problems, served as public spokesman, managed development of patented wastewater treatment process to eliminate effluent toxicity and avoid fines, and developed and enforced a systematic land use program resulting in \$100,000 per year land income.

GARY P. UEBELHOER

Education

MBA	Business Administration	Purdue	1976
B.S.	Environmental Engineering	Purdue	1975

LORI A. KOTZER
ASSOCIATE SCIENTIST

Areas of Specialization

Underground Storage Tank Investigations, Contamination Assessments, Project Management, Quality Control/Quality Assurance Operations, Laboratory Functions, and Regulatory Agency relations.

Relevant Experience

QA Manager; Electronic Products Site--Prepared and directed the Quality Assurance Project Plan for field and laboratory operations pertaining to site contamination assessment activities. The extent of groundwater contamination was determined through soil and groundwater analyses. Responsibilities included the surveillance of laboratory and field quality control operations, negotiations and interactions with local and state regulatory agencies, and compilation of Quality Assurance Plan.

QA Manager; Manufactured Gas Plant--Prepared Quality Assurance Project Plan for this former coal gasification plant site that had operated from the 1890s to the 1930s in Pensacola, Florida. This contamination assessment project involved twelve exploratory soil borings, six monitor well installations, and stormwater runoff pattern analysis. Contamination Assessment Plans, Quality Assurance Project Plans, and Health and Safety Plans were prepared and approved prior to the implementation of the field activities.

QA Manager; Manufactured Gas Plant--Prepared and directed the Quality Assurance Plan for this facility located in West Palm Beach, Florida. The scope of the contamination assessment included the drilling of twenty-six (26) soil borings, soil sampling and analysis, sixteen surficial aquifer monitor wells, groundwater sampling and analysis, and stormwater runoff pattern determination. Project parameters were specific for polynuclear aromatic hydrocarbons and heavy metals in the areal and vertical extent of soil and groundwater confines.

Primary Coordinator; State of Florida--Responsible for administering the State Underground Petroleum Emergency Response Act for Hillsborough County. Compiled potable well contamination data, arrived at hypotheses as to contamination source locations, and directed all data to the Florida Department of Environmental Regulation and Environmental Protection Commission of Hillsborough County.

QA/QC Coordinator; Cocoa, FL--Directed quality assurance objectives for a state certified laboratory. Maintained documentation in support of quality assurance/quality control functioning.

Task Manager; Duval County School Board--Participated in the project management of the Asbestos Hazardous Emergency Response Act Survey reports and management plans.

LORI A. KOTZER

Education

B.S.	Pre-Professional/Florida Institute Biological Sciences of Technology	1988
Mineral Identification Certification	McCrone Research Institute	1989

Professional Associations

Florida Society of Electron Microscopy, National Asbestos Council, and Florida Environmental Health Association

Publications

Hubel, S.B., Park, J.C., Kotzer, L.A., 1986. Pigment Accumulation in the Vestibular Epithelium of the Aging C-57BL/6NNIA Mouse. In Proceedings of the Southeast Electron Microscopy Society (Abstract), 9:32.

RICHARD J. POWELL, P.E.
SENIOR PROJECT MANAGER

Areas of Specialization

Project Management, Hazardous and Industrial Waste Treatment, Hazardous Materials Management, RCRA Permitting (Construction Operation and Closure), Reclamation and Process Evaluation and Design, Environmental Audits, Contamination Assessments, Environmental Permitting, and Feasibility Studies.

Project Management; Hillsborough County, Florida: Closure of the Sydney Mine Waste Disposal site-- The Sydney Mine Waste Disposal site was permitted by FDER as a land disposal area for septage waste oil sludges and grease trap wastes. Closure was mandated by FDER after groundwater was found to be contaminated. Closure assessment incorporated the following: soil, sludge, surface water, groundwater and air sampling, groundwater monitor well placement and construction, magnetometer survey, ground penetrating radar survey, soil borings, confirmatory excavations, Remedial measures involved onsite soil/sludge and water incineration, slurry wall construction, groundwater reclamation (pumping and vacuum), soil vacuuming, flow equalization, airstripping, carbon adsorption, groundwater recharge and soil farming, and pilot operations.

Project Management; Closure Plan Preparation, Florida Tile: Lakeland, Florida-- Plan involved the reconfiguration of surface impoundments to provide for facility stabilization. Designed coping system to preclude surface water and obtain regulatory approval.

Project Management; Permit Writer, Sparkle Corporation: Tampa, Florida-- Preparation of hazardous waste permit application for existing tank storage facility. Tank storage facility incorporated aboveground facilities, underground ground transport, secondary contained lines and recycled processing of mineral spirits. Facility also included the tank storage of chlorinated hydrocarbon (methylene chloride).

Project Management; Permit Writer and Closure Certification, Sparkle Corporation: Tampa, Florida-- Developed Closure Plan and permit application for hazardous waste storage facility. Plan incorporated clean closure of onsite tankage and subsurface transport line. Developed and implemented a required subsurface sampling and testing program to confirm clean closure for the facility.

Relevant Experience

Project Manager; Department of Energy (General Electric)-- Preparation and Certification of RCRA operations permit application for Department of Energy Neutron Activator Device facility in Pinellas County Florida. Facility included solvent tank storage, sludge storage, drummed hazardous waste storage, neutralization and reactive metals treatment. Initial project timing required that the project be completed in less than 30 calendar days. Concurrent to permit application preparation RCRA a contingency plan was also developed

RICHARD J. POWELL, P.E.

which integrated then used procedures with the RCRA requirements. These projects required extensive facility coordination of the application preparation team and facility management, construction, and maintenance personnel.

Project Manager; Wenczel Tile, Exposure Assessment for Surface Impoundments-- Preparation of an exposure assessment for one surface impoundment containing heavy metals from glazing operations and ceramic tile production. The exposure assessment targeted the risk elements and transport mechanisms for the hazardous waste to local and area receptors.

Project Manager; Florida Tile, Exposure Assessment for Surface Impoundments-- Managed the preparation of an exposure assessment for onsite surface impoundment located on facility property. Hazardous waste consisted of waste process sludges containing heavy metals. The exposure assessment evaluated the transport potential for heavy metals through surface water, groundwater, airborne dust contact as well as other avenues of contact.

Project Manager; Sparkle Corporation, Tampa, Florida, Recycle and Storage Process Design, Construction, and Operation Permitting-- Application preparation and certification of process design included input to process configuration instrumentation and control. Storage design included capacity, siting, layout, construction and regulatory compliance. Permitting involved the documentation of a facility design contingency planning, failure mode assessment and certification.

**KIRK R. JOHNSON, P.G.
STAFF GEOLOGIST**

Areas of Specialization

Groundwater Quality and Geotechnical Investigations, Regulatory Protocol for Contamination Assessments, Groundwater Monitoring Plans for Industrial Waste and Solid Waste Facilities

Relevant Project Experience

Project Manager; Amoco Oil Company, Port Charlotte, FL--Directed and scheduled drilling, monitor well installation, and groundwater and soils sampling activities at petroleum cleanup site. Compiled all project data, interpreted site hydrogeologic conditions, tested applicable hypotheses, formulated conclusions and recommendations, and prepared contamination assessment report.

Case Preparation/Expert Witness Testimony; DOAH Case No. 89-6751, Polk County, FL--Provided technical support to legal counsel and expert witness testimony regarding the construction of a phosphogypsum storage impoundment. Issues in contention included HDPE liner integrity, site stability, potential for groundwater contamination, and stormwater management.

Project Geologist; Polk County Planning Division, Southwest Polk County, FL--Evaluated available hydrogeological and geotechnical information, identified deficiencies in available data, investigated potential for sinkhole development, and formulated conclusions and recommendations as to the suitability of a site for construction and operation of a hazardous waste treatment facility.

Case Preparation; DOAH Case No. 88-6009, Hillsborough County, FL--Provided technical support to legal counsel in preparation for and during administrative hearing proceedings related to the construction of a Class III Landfill. Issues in contention included HDPE liner integrity, site stability, groundwater quality, and stormwater management.

Project Manager; Amoco Oil Company, Largo, FL--Directed and scheduled drilling, monitor well installation, and groundwater and soils sampling activities for a petroleum cleanup site. Compiled all project data, interpreted site hydrogeologic conditions, tested applicable hypotheses, formulated conclusions and recommendations, and prepared contamination assessment report.

Primary Regulatory Coordinator; Areawide Contamination Assessment, Tampa, FL--Compiled available hydrogeologic and potable well contamination data, arrived at hypotheses as to source locations, and assisted in planning contamination assessment. Evaluated results of contamination assessment and directed next action. Investigation-

KIRK R. JOHNSON, P.G.

documented the collection and analysis of 20 groundwater samples in a way that allowed the data to withstand any relevant administrative or legal challenges. Sources of trichloroethylene contamination were identified at three separate properties.

Field Geologist; U.S. Naval Petroleum Reserve No. 3, Wyoming--Supervised drilling, sampling, coring, geophysical logging, and drill-stem testing at six exploratory borings. Made recommendations to DOE regarding stratigraphic zones of potential oil production.

Primary Regulatory Coordinator; Aluminum Fabrication Facility, Citrus County, FL--Responsible for approving plans for contamination assessment and evaluating reports of field investigations. Investigation involved the installation of 21 surficial aquifer monitor wells and 23 Floridan aquifer monitor wells. Investigation documented the collection and analysis of 44 groundwater samples in a way that allowed the data to withstand any relevant administrative or legal challenges. Three sources of solvent contamination were identified.

Primary Regulatory Coordinator; Pesticide Formulation Facility, Tampa, FL--Responsible for approving plans for contamination assessment and evaluating reports of field investigations. Investigation involved the installation of 25 monitor wells. Investigation documented the collection and analysis of 25 groundwater samples and 26 soil samples in a way that allowed the data to withstand any relevant administrative or legal challenges. Two sources of contamination were identified.

Phosphogypsum Coordinator; Florida Department of Environmental Regulation--Compiled facility operations and groundwater quality information at 15 phosphogypsum storage impoundments in Central Florida. Identified common hydrogeology and groundwater quality aspects related to phosphogypsum storage sites. Presented status report to FDER Secretary. Coordinated with EPA in the development of an areawide phosphogypsum EIS supplement. Participated in evaluating the use of phosphogypsum as road construction materials.

Primary Regulatory Coordinator; Paint Manufacturing Facility, Hillsborough County, FL--Responsible for approving plans for contamination assessment and evaluating reports of field investigations. Investigation involved the installation of 24 monitor wells. Investigation documented the collection and analysis of 24 groundwater samples and 33 soil samples in a way that allowed the data to withstand any relevant administrative or legal challenges. Three sources of contamination were identified.

Primary Regulatory Coordinator; Transformer Repair Facility, Sumter County, FL--Responsible for approving plans for contamination assessment and evaluating reports of field investigations. Investigation involved the installation of 3 surficial aquifer and 14 Floridan aquifer monitor wells. Investigation documented the collection and analysis of 17

KIRK R. JOHNSON, P.G.

groundwater samples and numerous soil samples in a way that allowed the data to withstand any relevant administrative or legal challenges. A single source of PCB and solvent contamination was identified and eliminated.

Primary Regulatory Coordinator; Electronic Components Manufacturer, Sarasota County, FL--Responsible for approving plans for contamination assessment and evaluating reports of field investigations. Investigation involved the installation of 36 surficial aquifer and 3 Floridan aquifer monitor wells. Numerous groundwater, soil, and sediment samples were collected in a way that allowed the data to withstand any relevant administrative or legal challenges.

Primary Regulatory Coordinator; Manufacturer of Electronic and Mechanical Equipment for Nuclear Weapons Applications, Pinellas County, FL--Responsible for approving plans for contamination assessment and evaluating reports of field investigations. Investigation involved the installation of 67 monitor wells. Investigation documented the collection and analysis of numerous groundwater samples in a way that allowed the data to withstand any relevant administrative or legal challenges. Two major sources of contamination were identified. Twelve additional sources were investigated. Eighty-three buried drums were located and excavated for appropriate disposal.

Primary Regulatory Coordinator; Areawide Contamination Assessment, Hillsborough County, FL--Compiled available hydrogeologic and potable well contamination data; arrived at hypotheses as to source locations; assisted in planning contamination assessment and evaluated results. Investigation documented the collection and analysis of 25 groundwater samples in a way that allowed the data to withstand any relevant administrative or legal challenges. One source of solvent and petroleum contamination was identified.

Primary Regulatory Coordinator; Electronic Components Manufacturer, Tampa, FL--Responsible for approving plans for contamination assessment and evaluating reports of field investigations. Investigation involved the installation of 25 surficial aquifer and 10 Floridan aquifer monitor wells. Investigation documented the collection and analysis of numerous groundwater samples in a way that allowed the data to withstand any relevant administrative or legal challenges. Two sources of solvent contamination were identified.

Education

B.A.	Geology	University of South Florida	1980
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KIRK R. JOHNSON, P.G.

Registration and Certification

Certified Professional Geologist, State of Florida
Hazardous Waste Site Sampling, EPA, September 1986
Incident Mitigation and Treatment Methods, EPA, February 1987
Introduction to Groundwater Investigations, EPA, February 1987
Personnel Protection and Safety, EPA, April 1986
Behavior of Soils, Clemson University, May 1988

Associations

American Association of Petroleum Geology

CHARLES D. HENDRY, Ph.D.
VICE PRESIDENT/PRINCIPAL ENGINEER

Areas of Specialization

Hazardous Waste Site Investigations, Feasibility Studies, Risk Assessments, Physical-Chemical Transport of Toxic/Hazardous Chemicals, Environmental Fate of Toxic/Hazardous Chemicals, Aquatic Chemistry, Water Quality.

General Experience

Vice President and Manager, Tampa Office, Environmental Consulting & Technology, Inc., (ECT), 1989-present.

Associate Vice President and Manager, Tampa Office, Hunter/ESE, Inc., 1986-1989.

Project Manager, Hazardous Waste Division, Environmental Science and Engineering, Inc., 1983-1986.

Project Manager, Water Resources Division, Environmental Science and Engineering, Inc., 1980-1983.

Relevant Project Experience

Project Manager; City of St. Petersburg, Suncoast Dome Stadium Site Contamination Assessment-Remedial Action Plan--Performed an investigation to determine the extent of soil and groundwater contamination at a former coal-gas production plant in downtown St. Petersburg. Investigation included the installation of 21 piezometers and groundwater monitor wells and the sampling and chemical analysis of soils, sediments, groundwater, and surface water in the vicinity of the site. Based on the results of the contamination assessment, an exposure and risk analysis was performed to assess the potential for effects to human health and the environment. A feasibility study and remedial action plan were developed to remediate site contaminants based on the results of the contamination assessment and risk analysis.

Project Manager; Gainesville Regional Utilities, Contamination Assessment at Former Coal Gasification Site--Performed a contamination assessment investigation at a former coal gasification plant site that had operated from the 1890s to 1960 in Gainesville, Florida. The contamination assessment included the installation of 6 monitor wells, the drilling of soil test borings, and the collection of groundwater and soil samples for laboratory chemical analyses. The monitor wells were used to measure water level elevations for determining hydraulic gradients and groundwater flow velocities. Contamination Assessment Plans, Quality Assurance Plans and Health and Safety Plans were prepared and approved prior to implementation of the field activities. Technical negotiations and interactions with local and state regulatory agencies were performed during the course of the investigation.

CHARLES D. HENDRY, Ph.D.

Project Manager; Confidential Client, Contamination Assessment at a Former Coal Gasification Site--Performed a contamination assessment to determine the areal and vertical extent of soil and groundwater contamination at a former coal gasification plant site in east-central Florida, where the gasification plant had operated from 1910 to 1960. The contamination assessment investigation included the drilling and sampling of soils from 12 soil test borings and the installation of 6 groundwater monitor wells. The monitor wells were used to obtain groundwater samples for chemical analyses and to measure water level elevations for hydraulic gradient determinations. Contamination Assessment Plans, Quality Assurance Plans, and Health and Safety Plans were prepared and approved prior to implementation of the field activities. Technical negotiations and interactions with local and state regulatory agencies were performed during the course of the investigation.

Project Director; Confidential Client, Feasibility Study for Former Coal Gasification Site, Remediation of Coal Tar--A feasibility study was conducted to select the most effective technical and economical remedial alternative for treatment/disposal of by-product coal tar wastes from the former (1910-1960) operation of a coal gasification plant. Remedial alternatives evaluated included in-situ solidification and vitrification and excavation followed by offsite incineration, bioremediation, and hazardous waste landfill treatment/disposal options. A feasibility study plan was prepared and technical negotiations and interactions with local and state regulatory agencies were performed during the course of the feasibility study.

Project Manager; Tampa Electric Company, Hazardous Waste Procedural Manuals, Tampa, FL--Prepared procedural manuals for handling of RCRA hazardous wastes generated at three electric power generating stations, six vehicle and equipment maintenance facilities, and one testing laboratory. The project scope included conducting initial operational audits of each facility to determine the types of wastes generated by various unit operations conducted at each facility. The manuals addressed procedures for containerized storage, inspection, shipping, and record keeping (manifest forms) to bring the facilities into compliance with RCRA regulations. The facilities included both large and small quantity generators.

Project Manager; Tampa Electric Company, Petroleum Contamination Investigation, Tampa, FL--Performed an investigation to assess soil and groundwater contamination at a former vehicle maintenance area where waste petroleum products had been disposed. Work performed included the installation of groundwater monitor wells, collection and analysis of groundwater samples, and collection and analysis of soil samples from soil borings. Head space soil gas measurements utilizing a photoionization detector also were made in the field to determine the levels of soil contamination. The project also included the supervision of the removal of two abandoned underground gasoline storage tanks and inspection of tanks and soils for leakage following tank removal. Recommendations for remediation of the site contaminants were made based on the results of the assessment.

CHARLES D. HENDRY, Ph.D.

Project Manager; Hazardous Waste Site Investigation, Cape Canaveral Air Force Station, Cape Canaveral, Florida--Performed contamination assessment of nine former hazardous waste disposal and fuel spill sites, including an explosives/ propellant detonation disposal site. The project scope included the use of remote geophysical sensing techniques to detect subsurface contamination; the installation of 50 groundwater monitor wells; and the sampling and chemical analysis of groundwater, surface water, soils, and sediments at the nine sites.

Project Manager; Hazardous Waste Site Investigation, Patrick Air Force Base, Cocoa Beach, Florida--Conducted contamination assessment of 17 former hazardous waste disposal and fuel spill sites, including several PCB spill sites. The project scope included the installation of 57 groundwater monitor wells; and the sampling and chemical analysis of groundwater, surface water, soils, and sediments at the 17 sites.

Project Manager; Remedial Investigation, Former NIKE Missile Site, Long Beach, California--Performed a Remedial Investigation for a former NIKE Missile Launch Facility at White Point, located 15 miles north of Long Beach, CA. The investigation at this 115-acre site included sampling of two abandoned underground fuel storage tanks, the drilling of two monitor wells at an abandoned landfill site, and the sampling of soils at fuel storage locations, transformer locations, and at two septic tank and drainfield locations. Supervised the removal of an abandoned 1,000-gal underground gasoline storage tank and collected soil samples beneath the tank during this investigation.

Project Director; Garrett Hydraulics Division, Ft. Lauderdale, FL--A contamination assessment was performed to determine the extent of chromium contamination in soils and groundwater. Field investigations included soil sampling, monitor well construction and groundwater sampling. A contamination assessment report and a remedial action plan were developed based on the site assessment. Construction oversight and verification sampling also were performed during excavation of a drainfield and soils contaminated with chromium.

Project Director; Lee County, Florida, Page Field Pesticide Contamination Assessment/Remedial Action, Ft. Myers, FL--Performed field investigations to determine the extent of soil and groundwater contamination by pesticide residues at a former crop duster facility at Page Field Airport. Field work included the installation of monitor wells and the collection of groundwater, surface water, soil, and sediment samples for laboratory chemical analyses. Project included an interim remedial action to remove soils contaminated with pesticide residues and the decontamination and removal of a former aircraft hanger and pesticide shop facility. Exposure and risk assessment tasks were performed to assess exposure and risk to human health and the environment using geohydrological data collected for the site. An analysis of adjacent land use and an inventory of water supply and irrigation wells within a one-mile radius of the site also were conducted.

CHARLES D. HENDRY, Ph.D.

Project Manager; Hazardous Waste Site Investigation, Charleston Naval Shipyard, Charleston, South Carolina--Managed evaluation and assessment of lead contamination in soils from storage of submarine batteries at the Defense Reutilization and Management Office (DRMO). Evaluation includes the collection and analysis of over 100 soil, airborne particulate, and dust samples. Recommendations for remedial action were based on human exposure risk assessments.

Project Manager; Hazardous Waste Site Investigation, Naval Coastal Systems Center, Panama City, Florida--Managed contamination assessment of former hazardous waste disposal and spill sites. The project scope included installation of monitor wells and the sampling and chemical analysis of groundwater, surface water, sediment, and soils at the seven sites.

Project Manager; Hazardous Waste Site Investigation, Charleston Naval Weapons Station, Charleston, South Carolina--Responsible for contamination assessment of seven former hazardous waste disposal or spill sites, including a World War I fuse disposal site and pentachlorophenol dip tank site. The study includes installation of monitor wells and the sampling and chemical analysis of groundwater, surface water, sediment, and soils at the seven sites.

Deputy Project Manager; Hazardous Waste Remedial Investigation, West Virginia Ordnance Works, Point Pleasant West Virginia--Conducted assessment of contamination, contaminant migration, and potential remedial measures in soils, surface water/sediments, and groundwater as a result of past TNT manufacturing operations. The installation is listed 85th on the National Priority Listing (NPL) and is ranked first on the state of West Virginia's ranking of former hazardous waste disposal sites. Twelve areas are being evaluated, including the potential for contamination, assessment of the risks to human health and the environmental impact due to the contamination and/or contaminant migration, the identification and assessment of remedial action alternatives, and the development of remedial action plans for selected remedial measures.

Project Manager; Toxic/Hazardous Materials Handling and Disposal, USATHAMA and NEESA--Performed assessment of present and past handling and disposal practices for toxic/hazardous materials on 32 U.S. Army and Navy installations conducted for USATHAMA and NEESA. Project included evaluation of the potential for off-post migration of toxic materials, recommendations for sampling and analysis, and compliance with existing federal and state regulations.

CHARLES D. HENDRY, Ph.D.

Subproject Manager; Fate of Toxic Substances in the Environment, U.S. Environmental Protection Agency--Conducted assessment of the release transport and fate of toxic organic and inorganic substances in the environment. Assessment based on physical and chemical properties (e.g., volatility, solubility, photolysis, hydrolysis, sorption, and biodegradation) of the compounds and evaluation of predicted environmental concentrations using computer models.

Project Team Member; Assurance/Control, Alabama Army Ammunition Plant, Alabama--Responsible for analytical chemistry QA/QC for project. Conducted sampling and analysis of soils, waters, and biota at a U.S. Army ammunition manufacturing plant.

Technical Consultant; Atmospheric Deposition Study, Florida Power Coordinating Group--Conducted 3-year study measuring deposition of chemical substances by atmospheric precipitation. Included monitoring, source attribution studies, and ecological effects evaluation. Emphasis placed on water quality impacts.

Education

Ph.D.	1983	Environmental Engineering	University of Florida
M.S.	1977	Environmental Engineering	University of Florida
B.S.	1974	Chemistry	University of Florida

Registrations and Certifications

Certified, Employee Development Course in Hazardous Materials and Site Investigations, April 1984

Associations

Sigma Xi
American Chemical Society
American Chemical Society
Water Pollution Control Federation
Air Pollution Control Association

GUY T. KAMINSKI, P.E.
SENIOR ENGINEER

Areas of Specialization

Environmental Engineering, Hazardous and Industrial Waste Treatment Technologies, Remedial Design, Cost Estimating, Contamination Assessment, Civil Site Design, Hydrology.

Relevant Experience

Technical Support Group Engineer; Zone Program Management Office, Remedial Engineering Management III, Arlington, Virginia--Provide technical oversight and review of work conducted under the REM III Superfund contract. Responsibilities include monitoring investigation and remedial activities conducted at National Priority List (NPL) sites located in seven EPA regions, review and technical supervision on Work Plans, Field Operation Plans, Remedial Investigations, Feasibility Studies, and Treatability Studies, and review and development of drilling, sampling, surveying, and treatability proposals and technical specifications.

Project Engineer; Feasibility Study for Contaminated Soils and Waste, Bypass 601 Site, North Carolina--Conducted feasibility study in accordance with SARA guidelines for EPA under REM III contract. Project involved development of remedial objectives, evaluation remedial technologies and alternatives for NPL site. Developed detailed remedial alternatives for soil and debris contaminated with lead, chrome, nickel, and sulfates.

Project Manager; RCRA Waste Minimization Study, Letterkenny Army Depot, USATHAMA--Conducting waste minimization study for paint stripping process which generates RCRA characteristic hazardous waste. Developed waste characterization plan. Conducted technology review and evaluation to reduce waste and improve process performance. Produced specifications and testing plan for pilot study of solid liquid separation equipment.

Project Engineer; Feasibility Study for Contaminated Soils and Subsurface Gas, Waste Disposal Incorporated, Santa Fe Springs, California--Conducted feasibility study in accordance with SARA guidelines for EPA under REM III contract. Developed and evaluated remedial alternatives for large land disposal NPL site with pesticide, PCB, volatile, and inorganic contaminants.

Project Engineer; Feasibility Study for Contaminated Soils and Groundwater, SMS Instruments, Long Island, New York--Developed feasibility study in accordance with SARA guidelines for EPA under REM III contract. The study detailed and evaluated remedial alternatives for soil and groundwater contaminated with volatile and semi-volatile organics. Record of Decision has been made for treating contaminated groundwater and soil. System currently being developed under EPA Alternative Remedial Contract (ARCS).

GUY T. KAMINSKI, P.E.

Project Manager; Tank Farm Remediation Feasibility Study, Naval Supply Center, Charleston South Carolina--Conducted feasibility study evaluating and cost estimating various remedial alternatives for soils and groundwater contaminated with fuel oil. The feasibility study included a remedial action plan describing the implementation of the selected alternatives.

Project Manager and Engineer; Contaminated groundwater Treatability Study, Wells G & H, Woburn, Massachusetts--Project involved treatability study of two contaminated groundwater sources at the Wells G & H (NPL) site. Groundwater at the site was naturally high in iron and manganese and was contaminated with volatile organic solvents and trace semi-volatile organics. The study evaluated pretreatment processes for the removal of metals, air stripping for the removal of volatile organics, and carbon adsorption for the removal of semi-volatile organics.

Project Engineer; Industrial Wastewater Treatment Assessment, Sparton Electronics, Brooksville, Florida--Performed assessment of waste streams associated with electrical circuit board manufacturing facility. Conducted treatability study to evaluate unit operations and optimize existing industrial pretreatment system. Designed system for removal of suspended solids and inorganics. Successive filters and neutralization provided an effluent acceptable for discharge to a biological treatment plant.

Treatability Study on Contaminated Surface and Groundwater, Bog Creek, New Jersey--Conducted treatability study on contaminated groundwater and surface water contaminated with volatiles, semivolatiles, and inorganics at Bog Creek (NPL) site. The study evaluated the feasibility of chemical coagulation, chemical oxidation, filtration, air stripping, and carbon adsorption.

Team Engineer; Feasibility Study for Contaminated Sites at Letterkenny Army Depot, Pennsylvania--Reviewed remedial investigation, treatment technologies and pilot studies to develop remedial alternatives for soils contaminated with organic solvents. Feasibility study was performed under SARA guidelines.

Team Engineer; Feasibility Study for Contaminated Sites at Keesler Air Force Base, Biloxi, Mississippi--Reviewed remedial investigation and assembled and screened treatment technologies. Technologies which meet remedial response objectives were developed into remedial alternatives for contaminated soil, groundwater, and surface water.

Project Engineer; Broom, VanOstran and Associates, City of Okeechobee, Florida--Evaluated performance of a rapid infiltration system for removal of inorganic pollutants from the effluent of a 1.8 million gallons per day municipal secondary wastewater treatment facility. Performed laboratory phosphorus adsorption study on soils and used results to modeled fate and transport in full-scale percolation ponds. Established system size and wastewater loading criteria for rapid rate infiltration system.

GUY T. KAMINSKI, P.E.

Project Engineer; Sidney Colen and Associates, Clearwater, Florida--Drafted application which successfully obtained a permit to make modifications to 0.6 MGD domestic wastewater treatment facility. Modifications consist of surge tank construction to attenuate peak flows and prevent excess biological solids carryover.

Project Manager; Riverfront Groves, Inc., Vero Beach, Florida--Drafted State of Florida application for renewal of an industrial treatment and disposal system permit. Directed the development of groundwater monitoring plan for the irrigation disposal system.

Project Manager; Buckeye Cellulose Corporation, Perry, Florida--Performed assessment of wastewater effluent from 60 mgd oxidation pond system to determine reasons for high BOD and TSS. Provided recommendations to control treatment system and monitoring effluent to maintain performance within regulatory constraints.

Project Engineer; Biological Wastewater Treatment System Assessment, Sparton Electronics, Brooksville, Florida--Investigated and assessed existing sewage treatment plant upgrade. Provided operational guidance and treatment system modifications.

Team Engineer; U.S. Army Installation Assessments, USATHAMA, Aberdeen Proving Grounds, Maryland--Conducted environmental assessment of six (6) army facilities located in California, Michigan, New Mexico, New York, and Texas. Assessment investigated and evaluated environmental/hazardous waste release and disposal conditions at each facility. Project involved review of installation records, site conditions, and operations for compliance to state and federal environmental regulations. Prepared reports of findings and recommendations.

Environmental Transactional Audit of Furniture Manufacturing Facility, Collier-Keyworth, Inc., Gardner, Maryland--Conducted environmental transactional audit of one of the worlds largest furniture manufacturing facilities, located in Liberty, North Carolina. Project involved review of records and regulations for compliance to federal, state, and local regulations. The project also consisted of a site visit and investigation and concluded with a report of findings and recommendations.

Environmental Transactional Audit of Fiberglass Boat Manufacturing Facility, Mobile Home Industries, Tallahassee, Florida--Conducted environmental transactional audit of two fiberglass boat manufacturing facilities. Project involved site visit and investigation of facilities for compliance with state FDER and Right To Know regulations and also OSHA hazardous communications regulations.

GUY T. KAMINSKI, P.E.

Project Engineer; Greenfield Plantation, Sound Builders, Inc., Jacksonville, Florida--Responsible for design and cost estimating of sanitary sewer, pumping stations, water mains, drainage system, and roadway for 1,400-acre commercial and residential development in Jacksonville, Florida. The drainage system incorporated a large lagoon and boat lock system to the Intercoastal water way.

Project Engineer; First Coast Developers, Inc., St. Augustine, Florida--Project involved the design of a multifamily development on St. John's River in Palatka, Florida. Work included the expansion of wastewater treatment facility and design of water treatment plant, roads, and drainage system.

Project Engineer; Duval County School Board, Jacksonville, Florida--Responsibilities included design and preparation of permit applications for land disposal of wastewater treatment plant effluent. Wastewater treatment systems service various Duval County public schools.

Design Engineer; U.S. Department of the Navy, Kings Bay, Georgia--Designed spill containment system for a hazardous waste storage and transportation facility at Kings Bay Submarine Base, Kings Bay, GA.

Project Engineer; Etonia Creek, Deltona Corporation, Miami, Florida--Prepared materials necessary for wetland permitting of a 7,000-acre development near Florahome, FL.

Design Engineer; City of Palatka, Palatka, Florida--Responsible for design of streets, drainage, and utilities for Community Block Grant Project, Palatka, FL.

Design Engineer; Golden Ocala, Inc., Marion County, Florida--Project included design of streets, drainage, and water distribution system for 200-acre residential and recreational development in Marion County, FL.

Team Engineer; City of Pontiac, Pontiac, Michigan--Responsibilities involved monitoring and assessing the performance of 2 MGD wastewater treatment plant modifications for nutrient removal. System alterations incorporated alternating aerobic/anaerobic wastewater treatment zones for nitrogen and phosphorus removal. Study provided recommendations for reducing chemicals for nutrient removal.

Design Engineer; Ford Motor Company, Detroit, Michigan--Developed and tested industrial pretreatment alternatives for removing volatile halocarbons from automobile paint operation effluent. Built and analyzed pilot-scale spray tower and surface aeration systems.

Team Engineer; General Motors Corporation, Detroit, Michigan--Conducted analysis of pilot-scale anaerobic filter and aeration polishing system to pretreat industrial machine lubricating and coolant wastewater.

GUY T. KAMINSKI, P.E.

Research Assistant; Department of Environmental Engineering, University of Michigan--Performed laboratory experiments to generate multicomponent carbon adsorption isotherms of priority pollutants in the presence of humic and fulvic acids. Isotherms provided data for modeling carbon adsorption of priority pollutants in natural waters.

Research Assistant; Great Lakes Research Division, University of Michigan--Performed laboratory analysis of water samples to determine balance and rate of atmospheric deposition of PAHs and PCBs in the Great Lakes.

Research Assistant; Great Lakes Research Division, University of Michigan--Research Assistant--Performed field sampling and laboratory analysis to determine extent and nature of contamination. Performed laboratory tests to determine potential success of various mitigative actions for river sediments.

Education

M.S. Environmental Engineering	University of Michigan	1984
B.S. Engineering	University of Michigan	1983

Registration

State of Florida, 1989

Associations

American Society of Civil Engineers
American Waterworks Association

APPENDIX C
ATI LEVEL III
DATA VALIDATION SOPs

APPENDIX C
ATI LEVEL III
DATA VALIDATION SOPs

Inorganics Analyses:

For analyses involving the use of atomic absorption (flame or furnace) spectrophotometry (AAS), inductively coupled plasma (ICP), ion chromatograph (IC), light (visible or ultraviolet) spectrophotometric methods, other turbidimetric, gravimetric, and autoanalyzer procedures, the following QA data should be provided where applicable:

1. Concentration of calibration curve standards;
2. Results of batch applicable Initial and Continuing Calibration Verification Standards (ICVS and CCVS), percent recoveries, and expected values analyzed with samples;
3. Results of batch applicable laboratory control samples (LCS) (may also be called QC check sample) but must be digested to evaluate method;
4. Results of method (laboratory control) blank analyses;
5. Results of interference check sample (ICS) analysis and expected value (ICP only);
6. Results of a dilution check sample and the expected value (ICP only);
7. Results of laboratory duplicate analyses;
8. Results of matrix spike (digested spike) analysis;
9. Results of analytical (post digested) spike analysis (furnace AAS only).

Organics Analyses:

1. Gas Chromatography (GC):

For analyses by GC, the following should be provided where applicable:

- a. Results of blanks:
 - (1) Water blanks: purgeables analysis;
 - (2) Sample preparation extraction (method) blanks;
 - (3) Trip blanks.
- b. Results of latest independent QC check samples analyzed, expected value, and percent recovery;

- c. Results of matrix spikes and calculated percent recovery, control limit, and source. Matrix spikes must be sample specific for submitted sample batches;
 - d. Results of matrix spike duplicates, calculated percent recoveries for matrix spike duplicate, relative percent difference (RPD) between matrix spike and matrix spike duplicate control limits, and source, if matrix spike duplicate analyzed. Matrix spike duplicates must be sample-specific for submitted sample batches;
 - e. Results of laboratory duplicates, RPD, control limits, and source (lab duplicates must be batch specific for samples submitted);
 - f. Results of surrogate spikes, percent recoveries, control limits, and source;
 - g. Results of blank spike analysis for organic matrix spike parameters not meeting matrix spike recovery requirements.
2. Gas Chromatography/Mass Spectrometer (GC/Mass Spec.):

For analyses by GC/Mass Spec., the following should be provided where applicable:

- a. Verification statement acknowledging tuning with BFB or DFTPP that indicates compliance with acceptance criteria;
- b. Results of continuing calibration standards, including results of system performance check compounds (SPCC) and expected value and calibration check compounds (CCC) and expected results;
- c. Results of water blanks, extraction (method) blanks analyses and trip blanks;
- d. Results of matrix spike and matrix spike duplicates, percent recoveries, and control limits, and control limit source. Matrix spikes must be sample specific for submitted sample batches;
- e. Results of surrogate spike recoveries, control limits, and a statement of control limit source;
- f. Results of calculation of relative percent difference (RPD) between matrix spike/matrix spike duplicate and RPD control limits;
- g. Results of latest independent quality control (EPA or NBS traceable) check samples analyzed (and the control value expected for each parameter);

- h. Results of blank spike analysis for matrix spike or matrix spike duplicate parameters not meeting recovery requirements.

APPENDIX D

QUALITY ASSURANCE PLAN
ANALYTICAL TECHNOLOGIES, INC.

Analytical Technologies, Inc.
(Formerly Pioneer Laboratory, Inc.)
11 East Olive Road
Pensacola, Florida 32514

Generic Quality Assurance Program

Submitted To:

Florida Department of Environmental Regulation
Quality Assurance Department
Tallahassee, Florida

January, 1991

W F Bowers
W.F. Bowers
General Manager

9-18-91
Date

Kelly S Swanson
Kelly S. Swanson
QA Officer

9-18-91
Date

Sylvia Labie
Sylvia Labie
FDER, QA Officer

Date

TABLE OF CONTENTS

SECTION	PAGE	DATE
1.0 Title Page	1-1	01/21/91
2.0 Table of Contents	2-1	11/03/90
3.0 QA Policy Statement	3-1	07/28/90
4.0 Laboratory Organization and Responsibility	4-1	01/21/91
5.0 Quality Assurance Objectives for Measurement of Data in Terms of Precision, Accuracy, Completeness, Representativeness, and Comparability	5-1	01/21/91
6.0 Sampling Procedures	6-1	01/21/91
6.1 Groundwater	6-1	01/21/91
6.1a Water Level Measurements-pH and Conductivity	6-1	01/21/91
6.1b Calculation of Well Purge Volumes	6-2	01/21/91
6.1c Purgeable	6-3	01/21/91
6.1d Sampling Capabilities	6-3	01/21/91
6.1e Equipment Used in Sampling	6-3	01/21/91
6.1f Preservation and Holding Times	6-3	01/21/91
6.2 Wastewater Sampling	6-4	01/21/91
6.2a Automatic Samplers	6-4	01/21/91
6.2b Manual Sampling	6-5	01/21/91
6.2c Special Sample Collection Procedures	6-5	01/21/91
6.3 Surface Water Sampling	6-6	01/21/91
6.3a Trace Organic Compounds and Metals	6-6	01/21/91
6.3b Bacterial	6-6	01/21/91
6.3c Purgeable Organic Compounds Analyses (VOA)	6-6	01/21/91
6.4 Potable Water Sampling	6-6	01/21/91
6.5 Soil Sampling	6-7	01/21/91
6.6 Landfills/Hazardous Waste Sites	6-7	01/21/91
6.7 Waste Sampling	6-7	01/21/91
6.7a Drums	6-7	01/21/91

SECTION	PAGE	DATE
6.8 In-House Decontamination and Cleaning Procedures for Field Equipment	6-22	01/21/91
6.8a In-house Cleaning Procedures for Teflon or Glass Field Sampling Equipment Used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses	6-22	01/21/91
6.8b In-house Cleaning Procedures for Stainless Steel or Metal Sampling Equipment Used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses for Soil	6-23	01/21/91
6.8c Well Sounders or Tapes Used to Measure Groundwater Levels	6-23	01/21/91
6.8d Teflon Sample Tubing	6-23	01/21/91
6.8e Cleaning of Bailers	6-25	01/21/91
6.9 In-house Decontamination and Cleaning Procedures For Field Equipment	6-25	01/21/91
6.9a Field Cleaning Procedures for Teflon or Glass Field Sampling Equipment Used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses	6-25	01/21/91
6.9b Field Cleaning Procedures for Stainless Steel or Metal Sampling Equipment Used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses for Soil	6-26	01/21/91
6.9c Well Sounders or Tapes Used to Measure Groundwater Levels	6-26	01/21/91
6.10 Sample Containers	6-26	01/21/91
6.10a Volatile Organics	6-26	01/21/91
6.10b Metals & General Inorganic Parameters	6-27	01/21/91
6.10c Extractable Organics	6-27	01/21/91
6.10d Sludge, Soil, and Sediment for all Parameters (excluding purgeables)	6-28	01/21/91
6.11 Sample Documentation and Identification	6-28	01/21/91
6.11a Field Documentation	6-28	01/21/91
7.0 Sample Custody	7-1	07/28/90
7.1 Field Sample Operations	7-1	07/28/90
7.1a Reagents for Preservation	7-1	07/28/90

SECTION	PAGE	DATE
7.1b Sampling Equipment	7-4	07/28/90
7.1c Sample Labels	7-4	07/28/90
7.2 Laboratory Operations	7-4	07/28/90
8.0 Calibration Procedures and Frequency	8-1	01/21/91
9.0 Analytical Procedures	9-1	07/28/90
9.1 Laboratory Glassware	9-1	07/28/90
9.1a Organic Parameters	9-1	07/28/90
9.1b Trace Metal Parameters	9-1	07/28/90
9.1c Nutrient Parameters	9-2	07/28/90
9.1d Pipettes	9-2	07/28/90
10.0 Data Reduction, Validation, and Reporting	10-1	11/03/90
11.0 Field and Laboratory Control Checks	11-1	01/21/91
11.1 Method Blanks	11-1	01/21/91
11.2 Method Standards or Quality Control Check Samples	11-1	01/21/91
11.3 Spiked Samples	11-1	01/21/91
11.4 Split Samples	11-2	01/21/91
11.5 Blanks	11-2	01/21/91
11.6 Surrogate Spike Samples	11-4	01/21/91
11.7 Calibration Standards	11-4	01/21/91
12.0 Performance and Systems Audit	12-1	11/03/90
12.1 Internal	12-1	11/03/90
12.1a Systems Audit	12-1	11/03/90
12.1b Internal Performance Audit	12-2	11/03/90
12.2 External Audit	12-2	11/03/90
12.2a Regulatory Agencies	12-2	11/03/90
12.2b Performance Evaluations	12-2	11/03/90
13.0 Preventative Maintenance	13-1	07/28/90
13.1 Routine Preventative Maintenance Schedule	13-1	07/28/90
14.0 Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness	14-1	07/28/90
14.1 Precision	14-1	07/28/90
14.2 Accuracy	14-1	07/28/90
14.3 Completeness	14-3	07/28/90
14.4 Control Charts	14-3	07/28/90
14.4a Accuracy Control Charts	14-3	07/28/90
14.4b Precision Control Charts	14-4	07/28/90
14.4c Construction of Control Charts	14-5	07/28/90
14.4d Interpretation of Control Charts	14-5	07/28/90

SECTION		PAGE	DATE
15.0	Correction Action	15-1	07/28/90
15.1	Corrective Action Limits	15-1	07/28/90
15.2	Corrective Action for Field Activities	15-1	07/28/90
16.0	Quality Assurance Report to Management	16-1	07/28/90
17.0	Resumes	17-1	01/21/91

LIST OF FIGURES

FIGURE		PAGE	DATE
Figure 4.1	Laboratory Organization and Responsibility Chart	4-3	01/21/91
Figure 6.1	Diagram of System for Collecting Organics Through a Peristaltic Pump	6-30	01/21/91
Figure 6.2	Diagram of Recommended Field Filtration System for Trace Metals	6-31	01/21/91
Figure 6.3	Monitoring Well Sampling Field Data (DER Form AP1)	6-32	01/21/91
Figure 6.4	Specific Conductivity Calibration Form	6-33	01/21/91
Figure 6.5	pH Calibration Form	6-34	01/21/91
Figure 6.6	Sample Label With Preservation Noted and Sample Seal	6-35	01/21/91
Figure 6.7	Chain of Custody	6-36	01/21/91
Figure 7.1	Sample Preservative Reagent Log Book	7-3	07/28/90
Figure 7.2	Sample Master Log-in Sheet	7-6	07/28/90
Figure 7.3	Data Flow and Reporting Scheme	7-7	07/28/90
Figure 12.1	Quality Assurance Report Quarterly General Audit	12-2	11/03/90
Figure 13.1	Maintenance Log Form	13-2	07/28/90
Figure 13.2	General Analytical Instrumentation	13-3	07/28/90
Figure 13.3	Mass Spectrometer Data Systems	13-4	07/28/90
Figure 13.4	General Analytical Instrumentation	13-5	07/28/90
Figure 13.5	Thermal and Mechanical Devices	13-6	07/28/90

LIST OF TABLES

<u>TABLE</u>	<u>PAGE</u>	<u>DATE</u>
Table 5.1 Precision, Accuracy, and Completeness Data	5-2	01/21/91
Table 6.1 Sampling Capabilities	6-9	01/21/91
Table 6.2 Sampling Equipment - Types and Uses	6-10	01/21/91
Table 6.3 Requirements for Sample Containers, Preservation Procedures and Maximum Holding Times of Water and Soil Samples Including Those Approved Water Procedures Not Found in 40 CFR, 136	6-13	01/21/91
Table 8.1 Standard Calibration	8-2	01/21/91
Table 10.1 Calculations and Equations	10-2	11/03/90
Table 11.1 Surrogate Compounds and Accuracy Limits for EPA Methods	11-5	11/03/90
Table 16.1 Quality Assurance Reports Submittal Frequency	16-2	07/28/90

3.0 QA Policy Statement

Analytical Technologies, Inc. (formerly Pioneer Laboratory, Inc. hereinafter referred to as ATI) is a full-service, client-oriented analytical chemistry laboratory. ATI is committed to excellence in service and quality.

The Quality Assurance program is an essential part of analytical protocol and is used by all levels of the staff to detect and correct problems in the measurement process. The program's goal is to assure that consistently accurate data are being reported.

This document is designed to provide a uniform set of procedures for the trace organics and inorganic analysis of samples, documentation of methods, and their performance during a survey, and sample data verification from sample collection and processing, to the actual analyses and reporting of the data.

4.0 Laboratory Organization and Responsibility

ATI is staffed with conscientious, qualified scientists. ATI has four divisions:

1. GC VOA
1. GC/MS
2. GC Organics
3. Inorganics

Each division has a supervisor. The supervisors as well as the Quality Assurance Officer report directly to the General Manager of the laboratory.

The responsibilities of each key person are outlined below.

General Manager: The General Manager will ensure that all aspects of the laboratory are functioning and providing quality data in a timely manner.

Quality Assurance Officer: The Quality Assurance Officer is responsible for monitoring the Quality Assurance Program and assuring that the program is being conducted and adhered to. This responsibility includes internal audits, external audits, maintenance of Standard Operating Procedures and checking QA and data reports. No data will be reported until all QC data have been evaluated and data determined to be valid. The QA/QC data will be validated using the criteria as specified in the approved methods. The purpose of the validation is to assess precision, accuracy and calculation of the Method Detection Limit. Laboratory control limits are calculated to assure that the duplicates, spikes and blanks are in-control.

The Generic Quality Assurance Plan is written by the QA Officer and submitted to DER for approval. All information must be updated and revisions resubmitted as changes take place in the laboratory.

Project Manager: The Project Manager is responsible for the preplanning and preparation of all projects and to ensure that data is reported in a timely manner.

Supervisor: The supervisor is responsible for providing quality data on time. The supervisor will ensure that the proper Quality Control is analyzed along with all samples. Each supervisor is responsible for the technicians training and supervision.

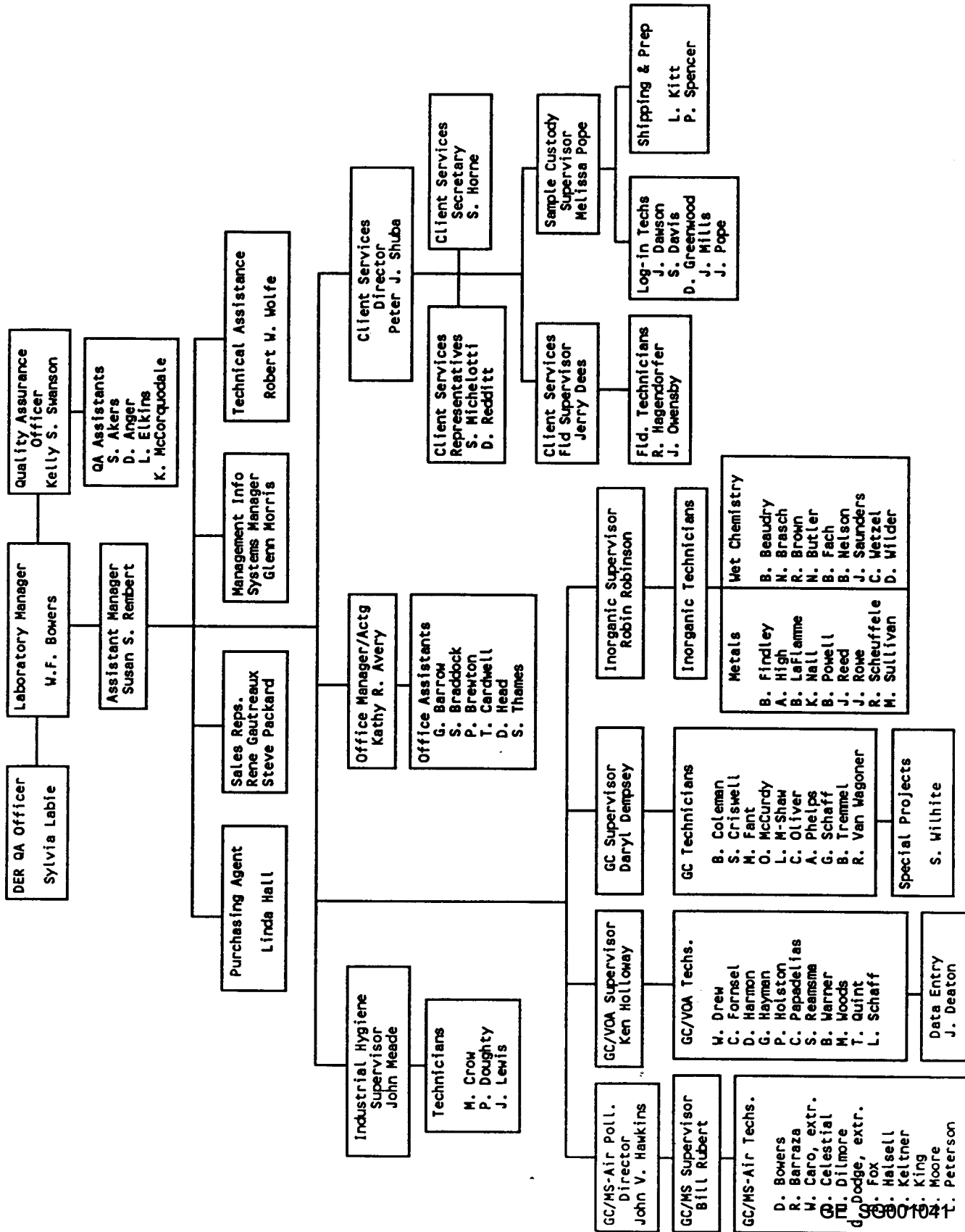
Field Technicians: The Field Technicians will make certain that all samples are collected by proper protocol in the proper containers and preserved correctly.

Sample Custody: Sample Custody is responsible for the receipt inspection, log-in, storage, and security of all samples.

Figure 4.1 illustrates overall laboratory organization.

Figure 4.1

ANALYTICAL TECHNOLOGIES, INC.
ORGANIZATION CHART



5.0 Quality Assurance Objectives for Measurement of Data in Terms of Precision, Accuracy, Completeness, Representativeness, and Comparability

Table 5.1 summarizes the organic and inorganic parameter methods and the precision, accuracy, and completeness of each parameter based on specific test methods.

Sampling and preservation procedures outlined in the Federal Register, 40 CFR, Part 136, July 1, 1988 and SW-846, 3rd Edition, November 1986, Table 6.3, are used to ensure that all results are representative of the sample media. Analytical procedures listed in the referenced methods of this section are used so all data are calculated and reported in units consistent with other organizations.

The precision and accuracy control limits are based on historical data from method validation studies using replicates, spikes and QC samples or EPA method control data. All precision and accuracy data generated from parameters that are routinely analyzed are based on historical data within the laboratory.

Table 5.1

INORGANIC PARAMETER METHODS
FOR WATER AND OTHER LIQUIDS,
SOIL, SLUDGE AND OTHER SEDIMENTS

Parameter	Matrix	EPA Method (Prep)	Detection Limit(ppm)	Accuracy % Recovery	sd	Precision RPD	sd	Reference	Note
<hr/>									
Metals									
Aluminum	Water	202.1 (3010)	0.1	96	2.1	6	4.3	1	
	Water	202.2 (3020)	0.003	109	6.8	12	4.9	1	
	Water	200.7 (3010)	0.1	102	5.6	7	5.0	1	
	Water	6010 (3010)	0.1	101	1.8	6	2.5	3	
	Water	7020 (3020)	0.1	99	3.3	10	5.0	3	
	Sludge/Soil	6010 (3050)	0.1	102	2.1	8	5.7	3	
	Sludge/Soil	7020 (3050)	0.1	78	9.8	12	1.2	3	
Antimony	Water	204.1 (3010)	0.2	97	7.1	8	5.7	1	
	Water	204.2 (3020)	0.003	99	7.6	10	3.3	1	
	Water	200.7 (3010)	0.05	90	7.7	7	5.0	1	
	Water	6010 (3010)	0.1	109	7.7	7	5.0	3	
	Water	7040 (3010)	0.1	115	5.0	8	2.3	3	
	Water	7041 (3020)	0.003	89	15.0	10	1.1	3	
	Sludge/Soil	6010 (3050)	0.1	109	7.7	7	5.0	3	
	Sludge/Soil	7040 (3050)	0.1	110	5.8	11	4.3	3	
Arsenic	Sludge/Soil	7041 (3050)	0.003	98	8.6	13	2.0	3	
	Water	206.2 (3020)	0.001	96	2.9	9	6.4	1	
	Water	200.7 (3010)	0.1	95	7.5	12	8.6	1	
	Water	6010 (3010)	0.1	101	7.5	11	7.9	3	
	Water	7060 (3020)	0.001	100	6.7	12	6.9	3	
	Sludge/Soil	6010 (3050)	0.1	101	7.5	11	7.9	3	
	Sludge/Soil	7060 (3050)	0.001	106	6.2	9	2.5	3	
Barium	Water	200.7 (3010)	0.1	103	6.5	7	5.0	1	
	Water	208.1 (3010)	0.1	94	7.1	4	2.9	1	
	Water	208.2 (3020)	0.002	80	6.6	9	3.1	1	
	Water	6010 (3010)	0.1	107	6.5	7	5.0	3	
	Water	7080 (3010)	0.1	100	10.1	10	5.0	3	
	Sludge/Soil	6010 (3050)	0.1	107	6.5	7	5.0	3	
	Sludge/Soil	7080 (3050)	0.1	99	8.9	11	3.0	3	
Beryllium	Water	210.1 (3010)	0.01	98	6.1	2	1.4	1	
	Water	210.2 (3020)	0.0002	89	7.2	8	2.6	1	
	Water	200.7 (3010)	0.01	100	4.8	5	3.6	1	
	Water	6010 (3010)	0.01	106	4.8	6	4.3	3	
	Water	7090 (3010)	0.01	102	5.5	9	2.1	3	
	Water	7091 (3020)	0.0002	98	8.7	8	3.3	3	
	Sludge/Soil	6010 (3050)	0.01	106	4.8	6	4.3	3	
	Sludge/Soil	7090 (3050)	0.01	95	5.5	10	1.0	3	
Boron	Sludge/Soil	7091 (3050)	0.0002	102	6.2	8	2.0	3	
	Water	200.7 (3010)	0.01	100	5.0	5	3.6	1	
	Water	6010 (3010)	0.01	100	5.0	5	3.6	3	
	Sludge/Soil	6010 (3050)	0.01	105	6.6	11	2.3	3	

Parameter	Matrix	EPA Method (Prep)	Detection Limit(ppm)	Accuracy % Recovery	Precision sd	RPD	sd	Reference	Note
Cadmium	Water	213.1 (3010)	0.01	101	6.3	4	2.9	1	
	Water	213.2 (3020)	0.0001	99	7.4	7	5.0	1	
	Water	200.7 (3010)	0.01	96	5.1	8	5.7	1	
	Water	6010 (3010)	0.01	99	5.1	7	5.0	3	
	Water	7130 (3010)	0.01	101	8.1	9	2.2	3	
	Water	7131 (3020)	0.0001	104	5.1	10	1.8	3	
	Sludge/Soil	6010 (3050)	0.01	99	5.1	7	5.0	3	
	Sludge/Soil	7130 (3050)	0.01	110	4.0	12	1.0	3	
	Sludge/Soil	7131 (3050)	0.0001	111	4.9	8	1.3	3	
Calcium	Water	200.7 (3010)	0.01	104	6.0	5	3.6	1	
	Water	215.1 (3010)	0.01	99	4.3	3	2.1	1	
	Water	6010 (3010)	0.01	118	8.5	6	4.0	3	
	Water	7140 (3010)	0.01	88	13.0	4	4.2	3	
	Sludge/Soil	6010 (3050)	0.01	122	9.5	9	1.0	3	
	Sludge/Soil	7140 (3050)	0.01	101	5.6	7	3.0	3	
Chromium VI	Water	7196	0.01	103	7.1	10	2.8	1	
	Sludge/Soil	7196	0.01	110	2.3	12	3.3	1	
Chromium	Water	218.1 (3010)	0.05	96	8.1	9	2.1	1	
	Water	218.2 (3020)	0.001	104	4.3	10	3.0	1	
	Water	200.7 (3010)	0.01	100	5.9	6	4.3	1	
	Water	6010 (3010)	0.01	102	5.9	5	3.6	3	
	Water	7190 (3010)	0.05	89	8.4	10	2.0	3	
	Water	7191 (3020)	0.001	100	5.5	9	2.8	3	
	Sludge/Soil	6010 (3050)	0.01	102	5.9	5	3.6	3	
	Sludge/Soil	7190 (3050)	0.05	110	9.7	8	3.7	3	
	Sludge/Soil	7191 (3050)	0.001	107	4.9	9	2.5	3	
Cobalt	Water	219.1 (3010)	0.05	98	1.3	2	1.4	1	
	Water	219.2 (3020)	0.001	88	3.0	6	3.2	1	
	Water	200.7 (3010)	0.05	96	5.0	5	3.6	1	
	Water	6010 (3010)	0.05	98	7.0	7	5.0	3	
	Water	7200 (3010)	0.05	111	3.5	10	0.9	3	
	Water	7201 (3020)	0.001	110	4.2	9	1.0	3	
	Sludge/Soil	6010 (3050)	0.05	98	7.0	7	5.0	3	
	Sludge/Soil	7200 (3050)	0.05	95	8.5	6	2.5	3	
	Sludge/Soil	7201 (3050)	0.001	92	4.9	8	1.8	3	
Copper	Water	220.1	0.02	96	7.1	4	2.9	1	
	Water	220.2 (3020)	0.001	94	7.0	7	5.0	1	
	Water	200.7 (3010)	0.02	94	6.7	6	4.3	1	
	Water	6010 (3010)	0.02	93	6.7	6	4.3	3	
	Water	7210 (3010)	0.02	101	5.2	10	2.0	3	
	Sludge/Soil	6010 (3050)	0.02	93	6.7	6	4.3	3	
	Sludge/Soil	7210 (3050)	0.02	105	7.7	9	3.0	3	
Gold	Water	231.1 (3010)	5.0	68	6.8	8	2.1	1	*
	Water	231.2 (3020)	5.0	82	3.6	6	5.2	1	*
Iron	Water	236.1 (3010)	0.03	96	5.0	5	3.6	1	
	Water	236.2 (3020)	0.001	105	8.1	8	3.1	1	
	Water	200.7 (3010)	0.02	102	7.1	6	4.3	1	
	Water	6010 (3010)	0.02	102	7.1	6	4.3	3	
	Sludge/Soil	6010 (3050)	0.02	98	10.2	10	1.8	3	

Parameter	Matrix	EPA Method (Prep)	Detection Limit(ppm)	Accuracy % Recovery	sd	Precision RPD	sd	Reference	Note
Lead	Water	239.1 (3010)	0.1	96	7.1	6	4.3	1	
	Water	239.2 (3020)	0.001	104	7.2	9	6.4	1	
	Water	200.7 (3010)	0.05	101	5.0	6	4.3	1	
	Water	6010 (3010)	0.05	98	5.0	10	7.1	3	
	Water	7420 (3010)	0.1	125	8.1	12	6.0	3	
	Water	7421 (3020)	0.001	110	10.2	9	6.3	3	
	Sludge/Soil	6010 (3050)	0.05	98	5.0	10	7.1	3	
	Sludge/Soil	7420 (3050)	0.1	127	5.7	13	5.0	3	
	Sludge/Soil	7421 (3050)	0.001	99	11.2	11	2.1	3	
Magnesium	Water	242.1 (3010)	0.001	100	4.6	2	1.4	1	
	Water	200.7 (3010)	0.01	105	4.5	6	4.3	1	
	Water	6010 (3010)	0.01	107	4.5	7	5.0	3	
	Sludge/Soil	6010 (3050)	0.01	111	6.2	9	2.9	3	
Manganese	Water	243.1 (3010)	0.01	97	4.0	4	2.9	1	
	Water	243.2 (3020)	0.0002	108	2.9	8	1.8	1	
	Water	200.7 (3010)	0.01	96	6.3	6	4.3	1	
	Water	6010 (3010)	0.01	100	6.3	7	5.0	3	
	Water	7460 (3010)	0.01	115	5.3	10	1.7	3	
	Sludge/Soil	6010 (3050)	0.01	100	6.3	7	5.0	3	
	Sludge/Soil	7460 (3050)	0.01	99	4.9	8	3.9	3	
Mercury	Water	245.1	0.0001	102	3.3	10	7.1	1	
	Water	7470	0.0001	89	6	20	16.0	3	
	Sludge/Soil	7471	0.0001	105	10.2	22	11.9	3	
Molybdenum	Water	246.1 (3010)	0.1	97	3.1	2	1.4	1	
	Water	246.2 (3020)	0.5	87	6.3	11	3.5	1	
	Water	200.7 (3010)	0.1	95	5.5	6	4.3	1	
	Water	6010 (3010)	0.1	100	5.5	5	3.6	3	
	Water	7480 (3010)	1.0	115	6.1	10	2.5	3	
	Water	7481 (3010)	1.0	101	7.5	9	8.2	3	
	Sludge/Soil	6010 (3050)	0.1	100	5.5	5	3.6	3	
	Sludge/Soil	7480 (3050)	5.0	102	3.9	10	2.8	3	
Nickel	Sludge/Soil	7481 (3050)	5.0	99	2.8	11	4.0	3	
	Water	249.1 (3010)	0.05	97	4.4	4	2.9	1	
	Water	249.2 (3020)	0.001	102	7.5	11	5.2	1	
	Water	200.7 (3010)	0.05	101	4.7	7	5.0	1	
	Water	6010 (3010)	0.05	106	4.7	7	5.0	3	
	Water	7520 (3010)	0.05	115	6.2	10	2.8	3	
	Sludge/Soil	6010 (3050)	0.05	106	4.7	7	5.0	3	
Osmium	Sludge/Soil	7520 (3050)	0.05	102	2.6	11	6.2	3	
	Water	200.7 (3010)	1.0	78	6.8	8	1.2	1	*
	Water	6010 (3010)	0.5	101	5.2	6	2.5	3	*
Palladium	Sludge/Soil	6010 (3050)	1.0	98	1.2	10	3.2	3	*
	Water	200.7 (3010)	0.5	88	5.6	5	1.0	1	*
	Water	6010 (3010)	1.0	87	8.2	11	0.8	3	*
Platinum	Sludge/Soil	6010 (3050)	1.0	96	6.3	6	2.2	3	*
	Water	200.7 (3010)	0.5	76	6.2	9	2.1	1	*
	Water	6010 (3010)	1.0	100	10.0	8	3.0	3	*
	Sludge/Soil	6010 (3050)	1.0	95	5.5	10	1.1	3	*

Parameter	Matrix	EPA Method (Prep)	Detection Limit(ppm)	Accuracy % Recovery	sd	Precision RPD	sd	Reference	Note
Potassium	Water	258.1 (3020)	0.01	98	4.6	2	1.4	1	
	Water	200.7 (3010)	0.01	89	3.9	17	3.0	1	
	Water	6010 (3010)	0.01	101	4.0	18	6.1	3	
	Water	7610 (3020)	0.01	75	6.8	8	2.5	3	
	Sludge/Soil	6010 (3050)	0.01	98	5.6	11	2.2	3	
	Sludge/Soil	7610 (3050)	0.01	105	2.1	10	3.2	3	
Rhodium	Water	200.7 (3010)	0.5	83	2.7	2	8.1	1	*
	Water	6010 (3010)	1.0	103	5.1	6	3.2	3	*
	Sludge/Soil	6010 (3050)	1.0	95	2.9	10	3.5	3	*
Selenium	Water	270.2 (3020)	0.003	95	5.6	6	4.3	1	
	Water	200.7 (3010)	0.2	96	5.6	6	4.3	1	
	Water	6010 (3010)	0.2	97	5.6	6	4.3	3	
	Water	7740 (3020)	0.003	103	3.9	10	0.7	3	
	Sludge/Soil	6010 (3050)	0.2	101	5.6	8	2.4	3	
	Sludge/Soil	7740 (3050)	0.003	110	8.2	9	3.8	3	
Silver	Water	272.1 (3010)	0.01	106	7.6	8	5.7	1	
	Water	272.2 (3020)	0.0002	102	6.9	18	2.9	1	
	Water	200.7 (3010)	0.01	104	6.1	15	0.7	1	
	Water	6010 (3010)	0.01	106	6.1	14	0.7	3	
	Water	7760 (3020)	0.0002	99	5.9	16	2.2	3	
	Water	7761 (3020)	0.0001	110	2.8	8	1.6	3	
	Sludge/Soil	6010 (3050)	0.01	101	2.8	9	1.9	3	
	Sludge/Soil	7760 (3050)	0.0002	127	0.6	20	1.1	3	
	Sludge/Soil	7761 (3050)	0.0001	106	6.8	19	2.2	3	
Silica	Water	200.7 (3010)	1.0	101	4.0	4	2.9	1	
	Water	6010 (3010)	1.0	99	4.0	6	4.3	3	
	Sludge/Soil	6010 (3050)	1.0	100	2.6	11	2.0	3	
Sodium	Water	273.1 (3010)	0.2	98	3.2	5	3.6	1	
	Water	200.7 (3010)	0.2	102	8.5	10	3.5	1	
	Water	6010 (3010)	0.2	111	5.0	11	3.0	3	
	Water	7770 (3010)	0.2	89	8.8	8	2.1	3	
	Sludge/Soil	6010 (3050)	0.2	100	6.6	9	3.0	3	
	Sludge/Soil	7770 (3050)	0.2	78	5.9	6	5.2	3	
Strontium	Water	200.7 (3010)	0.01	102	4.9	7	5.0	1	*
	Water	6010 (3010)	0.01	102	4.9	6	4.3	3	*
	Sludge/Soil	6010 (3050)	0.01	111	7.0	11	6.0	3	*
Thallium	Water	279.1 (3010)	0.4	98	1.8	5	3.6	1	
	Water	279.2 (3020)	0.005	102	5.5	8	5.2	1	
	Water	200.7 (3010)	0.4	94	6.0	6	4.3	1	
	Water	6010 (3010)	0.4	100	8.0	8	5.7	3	
	Water	7840 (3010)	0.4	110	4.0	5	2.2	3	
	Water	7841 (3020)	0.005	89	8.8	10	1.0	3	
	Sludge/Soil	6010 (3050)	0.4	100	8.0	8	5.7	3	
	Sludge/Soil	7840 (3050)	0.4	106	0.9	12	1.1	3	
	Sludge/Soil	7841 (3050)	0.005	98	1.3	9	3.2	3	
Tin	Water	200.7 (3010)	1.0	101	3.2	4	2.9	1	
	Water	282.1 (3010)	1.0	98	2.5	5	3.6	1	
	Water	282.2 (3020)	1.5	100	3.2	10	1.2	1	
	Water	6010 (3010)	1.0	101	3.2	4	2.9	3	
	Water	7870 (3010)	1.0	99	8.6	8	3.0	3	
	Sludge/Soil	6010 (3050)	1.0	101	3.2	4	2.9	3	
	Sludge/Soil	7870 (3050)	1.0	120	5.0	11	2.0	3	
Titanium	Water	200.7 (3010)	0.01	106	5.1	6	4.3	1	*
	Water	283.1 (3010)	0.01	92	6.2	6	4.3	1	*
	Water	283.2 (3020)	0.01	110	9.2	11	2.0	1	*
	Water	6010 (3010)	0.01	100	5.0	5	3.6	3	*
	Sludge/Soil	6010 (3050)	0.01	101	5.5	9	2.9	3	*

Parameter	Matrix	EPA Method (Prep)	Detection Limit(ppm)	Accuracy % Recovery	sd	Precision RPD	sd	Reference	Note
Vanadium	Water	286.1 (3010)	0.2	97	7.0	2	1.4	1	
	Water	286.2 (3020)	0.004	110	6.2	9	0.9	1	
	Water	200.7 (3010)	0.2	97	5.0	5	3.6	1	
	Water	6010 (3010)	0.2	106	7.1	7	5.0	3	
	Sludge/Soil	6010 (3050)	0.2	111	5.9	10	1.0	3	
Zinc	Water	289.1 (3010)	0.01	97	6.1	5	3.6	1	
	Water	289.2 (3020)	0.00005	100	5.9	9	5.2	1	
	Water	200.7 (3010)	0.01	101	4.7	7	5.0	1	
	Water	6010 (3010)	0.01	99	4.7	7	5.0	3	
	Water	7950 (3010)	0.01	111	6.0	10	4.2	3	
	Sludge/Soil	6010 (3050)	0.01	87	8.1	5	9.1	3	
	Sludge/Soil	7950 (3050)	0.01	103	5.8	12	3.0	3	
Nutrients									
NH4-N	Water	350.2		99	2.7	6	4.3	1	
TKN	Water	351.2	0.5	111	3.9	5	3.6	1	
N03-N	Water	353.2	0.1	110	2.6	9	6.4	1	
	Sludge/Soil	9200	1.0	110	2.6	9	6.4	3	
N03-N02	Water	353.2	0.1	110	2.6	9	6.4	1	
N02-N	Water	354.1	0.1	105	3.3	10	5.0	1	
Nitrate	Water	353.2	0.1	96	3.2	6	4.3	1	
	Sludge/Soil	9200	1.0	96	3.2	6	4.3	3	
Organic N	Water	351.2/350.1	0.05	97	1.8	7	5.0	1	
Orthophosphate phosphorus	Water	365.2	0.01	95	0.5	10	7.1	1	
Total Phosphorus	Water	365.4	0.01	96	7.2	9	6.4	1	
Demands									
5 Day BOD	Water	405.1	1.0	98	5.4	12	3.0	1	
5 Day Carbon BOD	Water	507.2	1.0	101	1.8	9	2.2	1	
COD	Water	410.1	5.0	108	7.7	4	2.9	1	
	Water	410.2	5.0	105	4.1	5	3.6	1	
	Water	410.3	5.0	87	8.5	6	0.9	1	
	Water	410.4	5.0	87	8.5	6	0.9	1	
TOC	Water	415.1	1.0	96	1.0	2	1.4	1	
	Sludge/Soil	9060	1.0	95	2.3	2	1.4	3	
General Parameters									
Acidity	Water	305.1	1.0	110	2.8	10	0.8	1	
Alkalinity	Water	310.1	1.0	107	3.0	7	5.0	1	
Bromine	Water	320.1	1.0	98	5.2	9	1.5	1	
Bromide	Water	320.1	0.01	85	1.9	6	5.1	1	
Chloride	Water	325.3	0.5	99	1.0	4	2.9	1	
	Sludge/Soil	9252	1.0	97	1.0	4	2.9	3	

Parameter	Matrix	EPA Method (Prep)	Detection Limit(ppm)	Accuracy % Recovery	sd	Precision RPD	sd	Reference	Note
General Parameters cont...									
Color	Water	110.2	5.0	88	5.9	12	2.0	1	
Fluoride	Water	340.2	0.01	101	3.6	5	3.6	1	
Hardness	Water	130.2	1.0	98	5.0	9	6.4	1	
pH	Water	150.1		96	0.1	2	1.4	1	
	Water	423		96	0.1	2	1.4	7	
	Sludge/Soil	9040		95	0.1	3	2.1	3	
	Sludge/Soil	9045		94	0.1	3	2.1	3	
Total Residue	Water	160.3	0.01%	85	5.0	30	2.0	1	
Dissolved Residue	Water	160.1	1.0	85	5.0	30	2.0	1	
	Water	2098	1.0	98	2.3	24	1.6	7	
Suspended Residue	Water	160.2	1.0	85	5.0	30	2.0	1	
Non-filter Residue	Water	160.2	1.0	102	2.9	11	3.2	1	
Settleable Residue	Water	160.5		100	1.2	9	5.1	1	
Volatile Residue	Water	160.4	1.0	98	6.6	10	4.1	1	
Sulfate	Water	375.4	1.0	100	3.8	7	5.0	1	
	Sludge/Soil	9038	1.0	96	5.6	6	4.3	3	
Turbidity	Water	180.1	0.1	85	8.1	4	1.2	1	
Residual Cl	Water	330.5	0.1	98	5.0	5	3.6	1	
Total Cyanide	Water	335.3	0.01	102	5.0	5	3.6	1	
	Sludge/Soil	9010	0.005	101	6.6	4	2.9	3	
Cyanide, Amenable	Water	335.1	0.005	102	6.6	5	3.6	1	
Oil & Grease	Water	413.1	1.0	101	0.9	4	2.9	1	
	Sludge/Soil	9070	1.0	106	0.9	7	5.0	3	
	Sludge/Soil	9071	1.0	105	0.9	7	5.0	3	
Dissolved oxygen	Water	360.1	0.1	101	1.0	3	2.1	1	
Total phenols	Water	420.1	0.001	102	6.6	7	5.0	1	
	Sludge/Soil	9065	0.01	101	7.6	4	2.9	3	
Elemental									
phosphorus	Water	365.2	0.5	95	9.2	10	7.1	1	*
Dissolved silica	Water	200.7	1.0	102	1.1	9	1.1	1	
Spec. conductance	Water	120.1	0.1	97	7.0	5	3.6	1	
	Water	205	uhom	97	7.0	5	3.6	7	
	Sludge/Soil	9050	0.1	97	7.0	4	2.9	3	
Sulfide	Water	376.1	0.05	100	2.3	11	2.0	1	
	Sludge/Soil	9030	0.05	99	5.2	12	7.1	3	
Sulfite	Water	377.1	0.05	76	4.3	8	2.0	1	*
Surfactants	Water	425.1	0.050	109	3.8	5	3.6	1	
Temperature	Water	170.1		102	2.9	10	1.0	1	
	Water	212		102	2.9	10	1.0	7	
Transparency	Water	180.1		95	1.1	11	3.0	1	*
Corrosivity	Water	203		92	2.8	7	1.1	1	
Odor	Water	140.1	1.0	88	3.8	4	2.2	1	*
Total Organic Halides	Water	450.1	1.0	98	2.0	2	1.4	1	
	Sludge/Soil	9020	10	89	2.0	4	2.9	3	
	Sludge/Soil/Oil	D808-81	100	87	4.0	15	3.6	6	
	Sludge/Soil/Oil	9252 (5050)*	100	99	5.8	18	2.0	3	

Parameter	Matrix	EPA Method (Prep)	Detection Limit(ppm)	Accuracy % Recovery	sd	Precision RPD	sd	Reference	Note
Hazardous Waste Characteristics									
Waste Ignitability	Water	1010		100	1.2	8	2.5	1	
	Sludge/Soil	1010		98	2.0	10	0.8	3	
Waste Corrosivity	Water	1110		87	3.6	15	1.5	1	
	Sludge/Soil	1110		76	8.2	9	2.4	3	
Waste Reactivity	Water	9010		88	4.5	5	2.6	1	
	Sludge/Soil	9010		95	1.6	7	3.5	3	
Ep-Toxicity Extraction	Water	1310		92	6.8	8	2.8	1	
	Sludge/Soil	1310		102	5.1	8	1.9	3	
Sulfate	Water	9038	1.0	110	3.5	10	1.2	3	
	Sludge/Soil	9038	1.0	88	1.2	12	1.4	3	
Sulfur	Water	9035 (5030)	5.0	79	3.6	11	3.3	3	
Formaldehyde	Water	NIOSH 2502	5.0	96	4.2	9	2.8	6	*
		NIOSH 3500	5.0	92	1.1	9	3.8	6	*
Cation Exchange (Ammonium Acetate)		9080		111	9.5	10	1.2	3	*
Cation Exchange (Sodium Acetate)		9081		130	10.1	12	4.5	3	*
Cyanide Weak acid Dissociable		412-H	1.0	120	4 .0	30	3.4	7	*
Microbiology									
Fecal Coliform	Water	909C	4/100 ml	97	3.1	10	2.1	7	
Total Coliform	Water	909A	1/100 ml	95	1.3	9	1.1	7	
	Sludge/Soil	909A		92	5.8	6	6.2	3	
Coliform Strep	Water	910B		102	2.5	15	0.9	7	
Taste	Water	211A		101	2.0	2	1.4	7	*
Salinity	Water	210A		99	3.0	3	2.1	7	
Petroleum Hydrocarbons	Water	418.1	1.0	90	2.0	20	3.0	1	
	Water	503E (5030)	1.0	90	2.1	11	2.3	7	
	Water	503C	1.0	90	2.0	9	1.5	7	
	Water	9073*	1.0	115	5.8	3	3.2	3	
	Sludge/Soil	9073*	1.0	90	2.0	9	1.5	3	
Tannin & Lignin	Water	513		105	1.6	8	5.1	7	*
(TCLP)		1311						3	
Toxic Characteristic Leaching Procedure	Appendix 1, 40 CFR, Part 268.								

* - Draft Method: SW-846, 3rd Edition November 1986.

ORGANIC PARAMETER METHODS
ACCURACY, PRECISION, DETECTION LIMITS AND COMPLETENESS DATA
FOR WATER AND OTHER LIQUIDS

Parameter	EPA Method (Prep)	Detection Limit (ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Chloroform	501.1	0.5	110	2.3	11	3.0	5	
Bromodichloromethane	501.1	0.5	106	2.0	13	2.0	5	
Chlorodibromomethane	501.1	0.5	108	3.1	10	2.5	5	
Bromoform	501.1	0.5	114	1.1	12	2.6	5	
Benzene	502.2	0.5	99	1.2	10	1.9	5	
Bromobenzene	502.2	0.5	99	1.7	10	5.4	5	
Bromochloroemethane	502.2	0.5	96	3.0	13	6.1	5	
Bromodichloromethane	502.2	0.5	97	2.9	15	5.1	5	
Bromoform	502.2	0.5	106	5.5	17	4.1	5	
Bromomethane	502.2	0.5	97	3.7	11	3.0	5	
n-Butylbenzene	502.2	0.5	100	4.4	12	5.1	5	
sec-Butylbenzene	502.2	0.5	97	2.6	10	5.1	5	
tert-Butylbenzene	502.2	0.5	98	2.3	10	6.0	5	
Carbon tetrachloride	502.2	0.5	92	3.3	10	7.3	5	
Chlorobenzene	502.2	0.5	100	1.0	11	5.4	5	
Chloroethane	502.2	0.5	96	3.8	12	5.1	5	
Chloroform	502.2	0.5	98	2.5	12	5.6	5	
Chloromethane	502.2	0.5	96	8.9	12	4.4	5	
2-Chlorotoluene	502.2	0.5	97	2.6	15	3.9	5	
4-Chlorotoluene	502.2	0.5	97	3.1	15	4.8	5	
Dibromochloromethane	502.2	0.5	97	2.7	15	6.1	5	
Dibromomethane	502.2	0.5	109	7.4	15	7.0	5	

Parameter	EPA Method (Prep)	Detection Limit (ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,2-Dichlorobenzene	502.2	0.5	102	2.1	13	3.0	5	
1,3-Dichlorobenzene	502.2	0.5	104	1.7	13	2.0	5	
1,4-Dichlorobenzene	502.2	0.5	98	2.3	13	2.0	5	
Dichlorodifluoromethane	502.2	0.5	89	5.9	10	1.1	5	
1,1-Dichloroethane	502.2	0.5	100	5.7	12	6.1	5	
1,2-Dichloroethane	502.2	0.5	100	3.8	15	7.2	5	
1,1-Dichloroethene	502.2	0.5	100	2.4	15	3.4	5	
cis-1,2-Dichloroethene	502.2	0.5	105	3.5	15	1.9	5	
trans-1,2-Dichloroethene	502.2	0.5	93	3.7	15	6.4	5	
1,2-Dichloropropane	502.2	0.5	103	3.8	15	5.8	5	
1,3-Dichloropropane	502.2	0.5	100	3.4	17	1.3	5	
2,2-Dichloropropane	502.2	0.5	105	3.6	18	6.1	5	
1,1-Dichloropropene	502.2	0.5	103	3.6	20	3.7	5	
Ethylbenzene	502.2	0.5	101	1.4	10	7.7	5	
Hexachlorobutadiene	502.2	0.5	98	8.3	12	1.1	5	
Isopropylbenzene	502.2	0.5	98	9.0	12	2.0	5	
p-Isopropyltoluene	502.2	0.5	98	2.4	12	6.0	5	
Methylene chloride	502.2	0.5	97	2.8	13	5.0	5	
Naphthalene	502.2	0.5	102	6.3	14	4.3	5	
n-Propylbenzene	502.2	0.5	103	2.0	14	1.1	5	
Styrene	502.2	0.5	104	1.4	16	4.9	5	
1,1,1,2-Tetrachloroethane	502.2	0.5	99	2.3	16	5.9	5	
1,1,2,2-Tetrachloroethane	502.2	0.5	99	6.8	10	6.1	5	
Tetrachloroethene	502.2	0.5	101	1.8	10	7.2	5	
Toluene	502.2	0.5	99	1.0	11	1.9	5	
1,2,3-Trichlorobenzene	502.2	0.5	98	3.1	12	3.0	5	
1,2,4-Trichlorobenzene	502.2	0.5	102	2.1	14	6.1	5	
1,1,1-Trichloroethane	502.2	0.5	104	3.4	16	5.4	5	

Parameter	EPA Method (Prep)	Detection Limit (ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,1,2-Trichloroethane	502.2	0.5	109	6.2	9	3.8	5	
Trichloroethene	502.2	0.5	96	3.5	9	1.3	5	
Trichlorofluoromethane	502.2	0.5	96	3.4	9	3.8	5	
1,2,3-Trichloropropane	502.2	0.5	99	2.3	12	1.5	5	
1,2,4-Trimethyl benzene	502.2	0.5	99	1.2	11	6.0	5	
1,3,5-Trimethyl benzene	502.2	0.5	101	1.4	13	2.5	5	
Vinyl chloride	502.2	0.5	109	5.4	15	2.5	5	
o-Xylene	502.2	0.5	99	1.0	13	2.5	5	
m-Xylene	502.2	0.5	100	1.4	15	7.5	5	
p-Xylene	502.2	0.5	99	1.0	15	3.8	5	
1,2-Dibromoethane (EDB)	504	0.02	110	2.0	15	1.9	5	
1,2-Dibromo-3-chloropropane	504	0.02	109	2.3	15	2.5	5	
Aldrin	505	0.007	106	18.9	10	6.0	5	
Atrazine	505	0.100	115	15.0	10	6.0	5	
Chlordane	505	0.14	94	8.0	10	7.1	5	
Dieldrin	505	0.12	87	20.0	10	8.9	5	
Endrin	505	0.60	119	25.0	10	9.1	5	
Heptachlor	505	0.003	77	13.3	10	7.6	5	
Alachlor	505	0.004	102	13.1	10	6.5	5	
Lindane	505	0.003	91	7.1	10	4.5	5	
Methoxychlor	505	0.950	100	21.0	10	10.0	5	
Metolachlor	505	0.100	125	12.6	15	1.6	5	*
Simazine	505	0.100	115	5.0	12	1.7	5	*
Toxaphene	505	1.0	130	12.6	13	2.9	5	
Atrazine	507	0.13	92	9.0	16	7.8	5	*
Alachlor	507	0.38	95	11.0	19	6.1	5	*
Metolachlor	507	0.75	92	11.0	20	6.9	5	*
Simazine	507	0.075	100	7.0	22	6.7	5	*
Dalapon	515.1	5.0	110	5.1	12	4.2	5	*

Parameter	EPA Method (Prep)	Detection Limit (ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Dinoseb	515.1	0.7	98	1.3	9	1.8	5	*
2,4'-D	515.1	1.2	102	2.5	8	2.0	5	
2,4,5-TP Silvex	515.1	0.2	105	1.1	7	3.3	5	
Picloram	515.1	0.5	95	2.8	9	1.1	5	*
Dicamba	515.1	0.3	92	5.0	5	4.2	5	*
Benzene	524.2	0.5	100	4.0	10	4.1	5	
Bromobenzene	524.2	0.5	89	7.0	15	3.2	5	
Bromodichloromethane	524.2	0.5	98	3.2	11	2.2	5	
Bromoform	524.2	0.5	93	6.0	12	2.3	5	
Bromomethane	524.2	0.5	96	4.3	9	3.7	5	
Carbon tetrachloride	524.2	0.5	100	2.4	12	5.0	5	
Chlorobenzene	524.2	0.5	98	3.6	13	1.6	5	
Chlorodibromomethane	524.2	0.5	94	13.6	13	2.2	5	
Chloroethane	524.2	0.5	98	6.1	15	3.9	5	
Chloroform	524.2	0.5	100	3.8	16	1.6	5	
Chloromethane	524.2	0.5	103	16.6	18	7.3	5	
o-Chlorotoluene	524.2	0.5	105	10.1	20	7.6	5	
p-Chlorotoluene	524.2	0.5	107	12.0	20	6.7	5	
Dibromomethane	524.2	0.5	104	13.1	10	6.2	5	
m-Dichlorobenzene	524.2	0.5	109	6.0	11	1.0	5	
O-Dichlorobenzene	524.2	0.5	110	9.2	12	1.7	5	
p-Dichlorobenzene	524.2	0.5	107	10.3	13	3.5	5	
1,1-Dichloroethane	524.2	0.5	97	5.2	16	4.2	5	
1,2-Dichloroethane	524.2	0.5	109	6.7	17	4.7	5	
cis-1,2-Dichloroethylene	524.2	0.5	95	5.9	19	5.1	5	
trans-1,2-Dichloroethylene	524.2	0.5	81	1.3	20	6.0	5	
1,1-Dichloroethylene	524.2	0.5	100	4.9	21	7.0	5	
Dichloromethane	524.2	0.5	100	4.8	11	5.6	5	
Dichlorodifluoromethane	524.2	0.5	99	6.7	13	6.6	5	

Parameter	EPA Method (Prep)	Detection Limit (ug/L)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,2-Dichloropropane	524.2	0.5	103	5.1	12	3.2	5	
1,3-Dichloropropane	524.2	0.5	90	6.1	12	3.6	5	
cis-1,3-Dichloropropane	524.2	0.5	113	5.4	15	4.2	5	
2,2-Dichloropropane	524.2	0.5	101	4.0	11	4.1	5	
1,1-Dichloropropene	524.2	0.5	98	6.8	10	3.7	5	
Trans-1,3-Dichloropropene	524.2	0.5	93	11.7	12	3.0	5	
Methyl-tert-butyl ether	524.2	0.5	97	2.3	12	1.9	5	
Ethylbenzene	524.2	0.5	97	5.6	13	2.6	5	
Styrene	524.2	0.5	98	10.0	16	1.1	5	
1,1,1,2-Tetrachloroethane	524.2	0.5	96	7.0	15	7.6	5	
1,1,2,2-Tetrachloroethane	524.2	0.5	96	11.0	15	5.4	5	
Tetrachloroethene	524.2	0.5	98	2.4	15	5.6	5	
Toluene	524.2	0.5	99	1.6	15	5.3	5	
1,1,1-Trichloroethane	524.2	0.5	104	2.4	16	3.9	5	
1,1,2-Trichloroethane	524.2	0.5	99	15.9	11	8.3	5	
Trichloroethylene	524.2	0.5	100	3.3	12	6.1	5	
Trichlorofluoromethane	524.2	0.5	107	2.7	13	6.6	5	
1,2,3-Trichloropropane	524.2	0.5	89	6.0	12	7.0	5	
Vinyl chloride	524.2	0.5	114	16.6	11	5.7	5	
o-Xylene	524.2	0.5	97	5.0	10	5.4	5	
m-Xylene	524.2	0.5	96	4.0	10	5.7	5	
p-Xylene	524.2	0.5	100	3.4	10	5.6	5	
Aldicarb	531	0.5	112	12.2	15	10.1	5	
Aldicarb Sulfoxide	531	0.5	100	1.8	15	9.4	5	
Aldicarb Sulfone	531	0.5	102	6.1	15	2.6	5	
Carbofuran	531	0.5	88	9.8	15	2.8	5	
Oxamyl	531	0.5	91	11.6	15	5.0	5	

Parameter	EPA Method (Prep)	Detection Limit (ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Benzyl chloride	8010 (5030)	5	114	4.6	20	4.5	3	
Bis(2-chloroethoxy)methane	8010 (5030)	50	116	10.0	21	6.1	3	
Bis(2-chloroisopropyl)ether	8010 (5030)	50	120	9.3	16	9.3	3	
Bromobenzene	8010 (5030)	3	115	8.1	17	10.1	3	
Bromodichloromethane	601/8010 (5030)	1	112	11.0	20	1.0	3,4	
Bromoform	601/8010 (5030)	2	96	12.0	21	2.4	3,4	
Bromomethane	601/8010 (5030)	2	76	20.0	36	9.4	3,4	
Carbon tetrachloride	601/8010 (5030)	1	98	15.0	20	3.9	3,4	
Chlorobenzene	601/8010 (5030)	1	100	15.0	18	1.2	3,4	
Chloroethane	601/8010 (5030)	5	99	15.0	14	6.3	3,4	
Chloroform	601/8010 (5030)	2	93	13.0	19	2.0	3,4	
1-Chlorohexane	8010 (5030)	5	108	10.0	20	14.0	3	
2-Chloroethylvinyl ether	601/8010 (5030)	5	110	12.0	13	6.7	3,4	
Chloromethane	601/8010 (5030)	5	77	18.0	28	13.0	3,4	
Chloromethylmethyl ether	8010 (5030)	50	99	13.0	25	6.0	3	
Chlorotoluene	8010 (5030)	1	97	14.0	26	9.0	3	
Dibromochloromethane	601/8010 (5030)	5	94	17.0	24	12.0	3,4	
Dibromomethane	8010 (5030)	5	96	17.0	26	11.0	3	
1,2-Dichlorobenzene	601/8010 (5030)	2	93	17.0	13	6.0	3,4	
1,3-Dichlorobenzene	601/8010 (5030)	2	95	14.0	23	2.3	3,4	
1,4-Dichlorobenzene	601/8010 (5030)	2	93	19.0	20	2.4	3,4	
Dichlorodifluoromethane	601/8010 (5030)	5	95	10.8	14	9.4	3,4	
1,1-Dichloroethane	601/8010 (5030)	1	98	8.7	29	4.0	3,4	

Parameter	EPA Method (Prep)	Detection Limit (ug/L)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,2-Dichloroethane	601/8010 (5030)	1	104	10.6	15	9.4	3,4	
1,1-Dichloroethylene	601/8010 (5030)	1	98	8.7	21	9.0	3,4	
trans-1,2-Dichloroethene	601/8010 (5030)	1	97	7.0	17	4.6	3,4	
Methylene chloride	601/8010 (5030)	5	91	9.3	21	4.3	3,4	
1,2-Dichloropropane	601/8010 (5030)	1	100	13.0	20	6.0	3,4	
cis-1,3-Dichloropropene	601 (5030)	5	100	14.0	20	7.3	4	
trans-1,3-Dichloropropene	601 (5030)	1	120	15.0	20	6.1	4	
1,1,2,2-Tetrachloroethane	601/8010 (5030)	1	111	11.0	22	7.8	3,4	
1,1,1,2-Tetrachloroethane	8010 (5030)	1	95	19.0	25	5.4	3	
Tetrachloroethylene	601/8010 (5030)	3	94	6.0	18	2.3	3,4	
1,1,1-Trichloroethane	601/8010 (5030)	1	90	16.0	20	3.7	3,4	
1,1,2-Trichloroethane	601/8010 (5030)	2	86	3.0	25	4.7	3,4	
Trichloroethylene	601/8010 (5030)	1	90	5.0	21	6.7	3,4	
Trichlorofluoromethane	601/8010 (5030)	1	95	6.7	16	3.4	3,4	
Trichloropropane	8010 (5030)	5	96	7.8	18	9.1	3	
Vinyl chloride	601/8010 (5030)	1	97	8.1	19	4.0	3,4	
1-Chlorohexane	601/8010 (5030)	5	108	9.0	20	6.7	3,4	
1,2-Dibromoethane (EDB)	*601/8010 (5030)	1	10	10	10	10	3	
Benzene	602/8020 (5030)	1	92	5.7	21	5.6	3,4	
Chlorobenzene	602/8020 (5030)	1	95	10.0	17	1.7	3,4	
1,2-Dichlorobenzene	602/8020 (5030)	2	93	5.2	22	5.3	3,4	
1,3-Dichlorobenzene	602/8020 (5030)	2	96	4.0	19	4.1	3,4	
1,4-Dichlorobenzene	602/8020 (5030)	2	93	9.0	20	7.1	3,4	
Ethylbenzene	602/8020 (5030)	1	94	3.1	21	5.9	3,4	
Toluene	602/8020 (5030)	1	93	6.5	15	4.6	3,4	
Xylenes	602/8020 (5030)	2	101	5.0	16	4.8	3,4	
Methyl Tert-Butyl Ether	8020 (5030)	5	95	8.7	21	5.9	3	

* - Must substitute EC Detector for Hall Detector.

Parameter	EPA Method (Prep)	Detection Limit (ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Acrolein	603/8030 (5030)	50	104	2.0	25	6.1	3,4	
Acrylonitrile	603/8030 (5030)	50	84	6.0	25	7.1	3,4	
Acetonitrile	8030 (5030)	1000	109	9.0	25	8.1	3	
2-Butanone (MEK)	8015 (5030)	10	102	2.6	10	3.2	3	*
Diethyl ether	8015 (5030)	100	68	8.2	26	6.0	3	*
1,4-Dioxane	8015 (5030)	150	110	6.7	9	3.6	3	*
Ethanol	8015 (5030)	200	100	5.2	12	1.8	3	*
Ethyl methacrylate	8015 (5030)	10	99	7.2	8	6.2	3	*
Isobutyl alcohol	8015 (5030)	100	85	6.9	14	1.9	3	*
Isopropyl alcohol	8015 (5030)	100	92	3.8	11	4.1	3	*
Methacrylonitrile	8015 (5030)	100	102	6.5	10	3.4	3	*
Methanol	8015 (5030)	1000	108	3.4	8	1.6	3	
Methyl methacrylate	8015 (5030)	10	113	2.6	16	5.3	3	*
4-Methyl-2-pentanone (MIBK)	8015 (5030)	100	83	9.1	12	3.8	3	*
Methyl-tert-butyl ether (MTBE)	8015 (5030)	10	125	3.1	9	4.3	3	*
Paraldehyde	8015 (5030)	200	89	6.1	13	3.2	3	*
Propionitrile	8015 (5030)	100	92	2.9	7	6.3	3	*
2-Chlorophenol	604/8040 (3510) (3520)	0.58 0.58	87 83	5.6 8.4	11 21	2.5 7.5	3,4 3,4	
4-Chloro-3-methyl phenol	604/8040 (3510) (3520)	1.8 1.8	102 87	2.3 1.2	11 16	3.0 1.4	3,4 3,4	
2,4-Dichlorophenol	604/8040 (3510) (3520)	0.68 0.68	100 83	4.4 4.8	12 18	5.1 6.2	3,4 3,4	
2,4-Dimethylphenol	604/8040 (3510) (3520)	0.63 0.63	97 62	2.7 16	15 30	6.1 8.9	3,4 3,4	
2,4-Dinitrophenol	604/8040 (3510) (3520)	0.50 0.50	106 80	5.5 15.8	17 27	4.1 4.5	3,4 3,4	
2-Methyl-4,6-dinitrophenol	604/8040 (3510) (3520)	0.50 0.50	100 109	4.4 16.1	12 29	5.1 6.6	3,4 3,4	
2-Nitrophenol	604/8040 (3510) (3520)	0.77 0.77	98 90	2.3 15.2	10 30	6.0 7.0	3,4 3,4	

Parameter	EPA Method (Prep)	Detection Limit (ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
4-Nitrophenol	604/8040 (3510)	0.60	101	1.4	13	2.5	3,4	
	(3520)	0.60	64	1.8	17	4.3	3,4	
Pentachlorophenol	604/8040 (3510)	0.60	110	2.0	15	1.9	3,4	
	(3520)	0.60	83	3.5	22	5.8	3,4	
Phenol	604/8040 (3510)	2.2	94	8.0	10	6.0	3,4	
	(3520)	2.2	84	9.5	20	8.8	3,4	
2,4,6-Trichlorophenol	604/8040 (3510)	0.60	95	11.0	19	6.1	3,4	
	(3520)	0.60	86	10.0	13	2.4	3,4	
Bis(2-ethylhexyl)phthalate	606/8060 (3510)	20	92	4.8	24	6.0	3,4	
	(3520)	20	86	15.4	26	7.3	3,4	
Butyl benzyl phthalate	606/8060 (3510)	15	93	18.0	22	4.8	3,4	
	(3520)	15	112	5.1	20	9.4	3,4	
Diethyl phthalate	606/8060 (3510)	31	84	11.8	2	1.4	3,4	
	(3520)	31	95	2.3	2	1.4	3,4	
Dimethyl phthalate	606/8060 (3510)	19	98	4.5	15	1.8	3,4	
	(3520)	19	93	5.1	13	5.7	3,4	
Di-n-butyl phthalate	606/8060 (3510)	14	101	4.5	25	5.0	3,4	
	(3520)	14	95	3.6	15	3.2	3,4	
Di-n-octyl phthalate	606/8060 (3510)	31	110	2.0	12	7.2	3,4	
	(3520)	31	95	2.3	9	3.0	3,4	
Aldrin	608/8080 (3510)	0.05	105	7.6	8	1.5	3,4	
	(3520)	0.05	108	4.7	10	4.2	3,4	
	617 (3510)	0.05	78	5.4	6	6.0	4	
alpha-BHC	608/8080 (3510)	0.05	75	5.0	25	5.3	3,4	
	(3520)	0.05	98	24	14	1.1	3,4	
	617 (3510)	0.05	95	8.9	15	3.4	4	
beta-BHC	608/8080 (3510)	0.05	101	4.1	25	11.0	3,4	
	(3520)	0.05	78	26	20	2.9	3,4	
	617 (3510)	0.05	95	7.2	21	3.2	4	
delta-BHC	608/8080 (3510)	0.10	94	17.1	30	14.8	3,4	
	(3520)	0.10	101	23	17	7.0	3,4	
	617 (3510)	0.10	97	6.1	16	7.6	4	
gamma-BHC (Lindane)	608/8080 (3510)	0.05	101	10.1	30	7.0	3,4	
	(3520)	0.05	86	23	15	7.1	3,4	
	617 (3510)	0.05	97	7.2	15	7.8	4	
Chlordane	608/8080 (3510)	0.10	72	7.7	13	1.5	3,4	
	(3520)	0.10	109	27	15	6.2	3,4	
	617 (3510)	0.10	107	20	15	5.9	4	

Parameter	EPA Method (Prep)	Detection Limit(ug/L)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
4,4'-DDD	608/8080 (3510)	0.10	98	11.0	30	4.4	3,4	
	(3520)	0.10	69	13	15	4.0	3,4	
	617 (3510)	0.10	67	6.0	11	5.4	4	
4,4'-DDE	608/8080 (3510)	0.05	101	10.1	30	7.0	3,4	
	(3520)	0.05	108	26	16	3.9	3,4	
	617 (3510)	0.05	85	6.0	37	6.7	4	
4,4'-DDT	608/8080 (3510)	0.10	97	2..6	10	5.1	3,4	
	(3520)	0.10	80	13	10	4.1	3,4	
	617 (3510)	0.10	91	4.5	15	6.1	4	
Dieldrin	608/8080 (3510)	0.05	106	2.0	13	2.0	3,4	
	(3520)	0.05	115	24	11	7.2	3,4	
	617 (3510)	0.05	98	9.8	12	5.3	4	
Endosulfan I	608/8080 (3510)	0.10	114	1.1	12	2.6	3,4	
	(3520)	0.10	114	28	15	6.0	3,4	
	617 (3510)	0.10	101	7.6	17	7.8	4	
Endosulfan II	608/8080 (3510)	0.05	97	2.6	10	5.1	3,4	
	(3520)	0.05	101	17	12	8.1	3,4	
	617 (3510)	0.05	93	4.8	11	7.2	4	
Endosulfan sulfate	608/8080 (3510)	0.50	92	3.3	10	7.3	3,4	
	(3520)	0.50	114	18	10	6.4	3,4	
	617 (3510)	0.50	97	10	10	5.0	4	
Endrin	608/8080 (3510)	0.10	98	2.3	10	6.0	3,4	
	(3520)	0.10	126	10.4	15	9.0	3,4	
	617 (3510)	0.10	75	12.5	17	7.3	4	
Endrin aldehyde	608/8080 (3510)	0.20	97	2.7	15	6.1	3,4	
	(3520)	0.20	119	12.6	18	6.1	3,4	
	617 (3510)	0.20	75	13.1	13	7.2	4	
Endrin ketone	608/8080 (3510)	0.1	96	3.8	12	5.1	3,4	
	(3520)	0.1	135	14.0	20	5.6	3,4	
	617 (3510)	0.1	101	18	20	6.6	4	
Heptachlor	608/8080 (3510)	0.05	110	2.3	11	3.0	3,4	
	(3520)	0.05	86	15.4	20	7.4	3,4	
Heptachlor epoxide	608/8080 (3510)	1.0	99	1.2	10	1.9	3,4	
	(3520)	1.0	113	12.6	20	9.6	3,4	
Methoxychlor	8080 (3510)	2.0	96	3.0	13	6.1	3	
	(3520)	2.0	99	21	15	8.3	3	
	617 (3510)	2.0	92	3.3	10	7.3	4	
Toxaphene	608/8080 (3510)	2.0	97	3.1	15	4.8	3,4	
	(3520)	2.0	127	23	16	7.1	3,4	
	617 (3510)	2.0	97	2.6	15	3.9	4	

Parameter	EPA Method (Prep)	Detection Limit (ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
PCB-1016	608/8080 (3510)	0.20	103	3.8	15	5.8	3,4	
	(3520)	0.20	81	5.0	12	4.6	3,4	
	617 (3510)	0.20	104	1.7	13	2.0	4	
PCB-1221	608/8080 (3510)	0.20	100	3.4	17	1.3	3,4	
	(3520)	0.20	96	6.5	11	1.0	3,4	
	617 (3510)	0.20	98	8.3	12	1.1	4	
PCB-1232	608/8080 (3510)	0.20	97	2.8	13	5.0	3,4	
	(3520)	0.20	91	10.7	13	9.1	3,4	
	617 (3510)	0.20	99	2.3	16	5.9	4	
PCB-1242	608/8080 (3510)	0.20	98	3.1	12	3.0	3,4	
	(3520)	0.20	93	7.0	11	3.2	3,4	
	617 (3510)	0.20	101	1.8	10	7.2	4	
PCB-1248	608/8080 (3510)	0.20	101	1.4	10	7.7	3,4	
	(3520)	0.20	97	10.6	12	6.1	3,4	
	617 (3510)	0.20	98	9.0	12	2.0	4	
PCB-1254	608/8080 (3510)	0.20	104	1.4	16	4.9	3,4	
	(3520)	0.20	76	20	17	2.3	3,4	
	617 (3510)	0.20	98	8.3	12	1.1	4	
PCB-1260	608/8080 (3510)	0.20	97	2.8	13	5.0	3,4	
	(3520)	0.20	66	4.7	10	1.0	3,4	
	617 (3510)	0.20	99	2.3	16	5.9	4	
Acenaphthene	610/8100 (3510)	1	96	12.0	21	2.4	3,4	
	610/8100 (3520)	1	82	5.4	39	7.6	3,4	
	610/8310 (3520)	1	89	6.4	20	3.0		
Acenaphthylene	610/8100 (3510)	1	100	15.0	18	1.2	3,4	
	610/8100 (3520)	1	69	18.9	36	2.9	3,4	
	610/8310 (3520)	1	71	17.0	17	7.1	3,4	
Anthracene	610/8100 (3510)	1	108	10.0	10	14.0	3,4	
	610/8100 (3520)	1	110	12.6	23	8.6	3,4	
	610/8310 (3520)	1	90	9.8	15	4.5	3,4	
Benzo(a)anthracene	610/8100 (3510)	1	77	18.0	28	13.0	3,4	
	610/8100 (3520)	1	73	5.0	28	4.0	3,4	
	610/8310 (3520)	1	71	11.0	12	3.4	3,4	
Benzo(a)pyrene	610/8100 (3510)	1	96	17.0	26	11.0	3,4	
	610/8100 (3520)	1	65	10.0	38	1.0	3,4	
	610/8310 (3520)	1	69	19.0	11	5.6	3,4	
Benzo(b)fluoranthene	610/8100 (3510)	1	95	14.0	23	2.3	3,4	
	610/8100 (3520)	1	78	21.0	10	4.0	3,4	
	610/8310 (3520)	1	80	17.0	9	6.6	3,4	
Benzo(k)fluoranthene	610/8100 (3510)	1	76	20.0	36	9.4	3,4	
	610/8100 (3520)	1	60	10.0	40	10.0	3,4	
	610/8310 (3520)	1	67	11.0	12	7.1	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Benzo(g,h,i)perylene	610/8100 (3510)	1	100	13.0	20	6.0	3,4	
	610/8100 (3520)	1	64	12.0	15	5.4	3,4	
	610/8310 (3520)	1	69	10.0	13	4.3	3,4	
Chrysene	610/8100 (3510)	1	91	9.3	21	4.3	3,4	
	610/8100 (3520)	1	77	18.0	16	7.0	3,4	
	610/8310 (3520)	1	70	19.0	21	4.9	3,4	
Fluoranthene	610/8100 (3510)	1	111	11.0	22	7.8	3,4	
	610/8100 (3520)	1	75	7.0	22	6.0	3,4	
	610/8310 (3520)	1	70	4.3	15	2.8	3,4	
Fluorene	610/8100 (3510)	1	90	5.0	21	6.7	3,4	
	610/8100 (3520)	1	108	5.2	40	11.2	3,4	
	610/8310 (3520)	1	98	7.9	25	8.0	3,4	
Indeno(1,2,3-cd)pyrene	610/8100 (3510)	1	92	5.7	21	5.6	3,4	
	610/8100 (3520)	1	80	6.0	29	7.0	3,4	
	610/8310 (3520)	1	95	8.5	20	4.6	3,4	
Dibenzo(a,h)anthracene	610/8100 (3510)	1	95	10.0	17	1.7	3,4	
	610/8100 (3520)	1	67	11.0	24	2.0	3,4	
	610/8310 (3520)	1	75	5.8	25	6.6	3,4	
1-Methylnaphthalene	610/8100 (3510)	1	94	3.1	21	5.9	3,4	
	610/8100 (3520)	1	110	10.0	28	5.6	3,4	
	610/8310 (3520)	1	95	8.5	15	1.3	3,4	
2-Methylnaphthalene	610/8100 (3510)	1	86	3.0	25	4.7	3,4	
	610/8100 (3520)	1	120	13.5	30	11.1	3,4	
	610/8310 (3520)	1	100	11.2	25	9.7	3,4	
Naphthalene	610/8100 (3510)	1	96	7.8	18	9.1	3,4	
	610/8100 (3520)	1	117	7.0	28	18.0	3,4	
	610/8310 (3520)	1	98	5.5	20	10.0	3,4	
Phenanthrene	610/8100 (3510)	1	95	8.0	17	4.6	3,4	
	610/8100 (3520)	1	125	9.5	30	5.0	3,4	
	610/8310 (3520)	1	102	8.9	22	6.8	3,4	
Pyrene	610/8100 (3510)	1	95	19.0	25	5.4	3,4	
	610/8100 (3520)	1	85	12.0	25	1.4	3,4	
	610/8310 (3520)	1	98	6.8	15	5.6	3,4	
Azinphos methyl	614/8140 (3510)	0.10	90	5.0	21	6.7	3,4	
	(3520)	0.10	73	18.8	26	10.0	3,4	
Bolstar	8140 (3510)	0.10	104	10.6	15	9.4	3	*
	(3520)	0.10	65	6.3	35	14.5	3	*
Chlorpyrifos	8140 (3510)	0.10	86	3.0	25	4.7	3	*
	(3520)	0.10	98	5.5	28	9.8	3	*
Coumaphos	8140 (3510)	0.10	90	6.1	25	11.7	3	*
	(3520)	0.10	109	12.7	30	11.5	3	*
Demeton-O	614/8140 (3510)	0.10	87	18.8	15	10.7	3,4	*
	(3520)	0.10	67	10.5	18	5.8	3,4	*

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Demeton-S	614/8140 (3510)	0.10	103	5.1	12	3.2	3,4	*
	(3520)	0.10	100	11.5	35	6.8	3,4	*
Diazinon	614/8140 (3510)	0.10	98	6.8	10	3.7	3,4	*
	(3520)	0.10	67	6.0	11	5.4	3,4	*
Dichlorvos	8140 (3510)	0.10	98	10.0	16	1.1	3	*
	(3520)	0.10	72	7.7	13	1.5	3	*
Disulfoton	614/8140 (3510)	0.10	104	2.4	16	3.9	3,4	*
	(3520)	0.10	82	9.0	20	8.9	3,4	*
Ethion	614 (3510)	0.10	89	6.0	12	7.0	4	*
	(3520)	0.10	97	5.0	10	5.4	4	*
Ethoprop	8140 (3510)	0.10	100	3.4	10	5.6	3	*
	(3520)	0.10	101	4.1	25	11.0	3	*
Fensulfothion	8140 (3510)	0.10	112	12.2	15	10.1	3	*
	(3520)	0.10	94	17.1	30	14.8	3	*
Fenthion	8140 (3510)	0.10	113	5.4	15	4.2	3	*
	(3520)	0.10	69	19.9	22	5.9	3	*
Malathion	614 (3510)	0.10	97	2.3	12	1.9	4	*
	(3520)	0.10	98	10.0	16	1.1	4	*
Merphos	8140 (3510)	0.05	97	3.6	15	4.3	3	*
	(3520)	0.05	121	7.9	35	16.5	3	*
Mevinphos	8140 (3510)	0.01	94	1.5	15	4.4	3	*
	(3520)	0.01	57	7.8	15	1.9	3	*
Parathion, ethyl	614 (3510)	0.10	93	6.0	14	5.4	4	*
	(3520)	0.10	77	6.5	15	4.2	4	*
Naled	8140 (3510)	0.10	86	3.0	13	5.6	3	*
	(3520)	0.10	78	8.1	20	5.6	3	*
Parathion, methyl	614/8140 (3510)	0.05	99	4.7	15	3.9	3,4	*
	(3520)	0.05	96	5.3	25	8.8	3,4	*
Phorate	8140 (3510)	0.01	100	5.3	14	5.7	3	*
	(3520)	0.01	63	8.9	13	1.5	3	*
Ronnel	8140 (3510)	0.01	97	4.4	12	5.8	3	*
	(3520)	0.01	99	5.6	18	5.2	3	*
Stirophos (Tetrachlorovinphos)	8140 (3510)	0.05	115	12.1	12	4.0	3	*
	(3520)	0.05	66	5.9	11	1.1	3	*
Tokuthion (Prothiofos)	8140 (3510)	0.05	89	15.0	23	7.0	3	*
	(3520)	0.05	65	6.8	16	1.4	3	*
Trichloronate	8140 (3510)	0.50	81	13.0	19	3.7	3	*
	(3520)	0.50	105	18.6	26	5.9	3	*

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
2,4-D	615/8150	0.5	75	4.0	12	1.6	3,4	
2,4-DB	615/8150	0.5	93	3.0	18	4.6	3,4	
2,4,5-T	615/8150	0.3	85	6.0	25	12.5	3,4	
2,4,5-TP (Silvex)	615/8150	0.1	88	5.0	20	9.8	3,4	
Dalapon	8150	10	66	8.0	36	15.2	3	
Dicamba	8150	0.1	79	7.0	32	9.8	3	
Dichloroprop	8150	0.5	97	2.0	27	11.2	3	
Dinoseb	8150	0.5	86	4.0	30	10.0	3	
MCPA	8150	10	98	4.0	25	5.8	3	
MCPP	8150	10	94	4.0	21	6.8	3	
Captan	617	1.0	64	12.0	15	5.4	4	*
Carbophenothion	617	1.0	98	7.9	25	8.0	4	*
Dichloran	617	1.0	67	11.0	24	2.0	4	*
Dicofol	617	0.1	95	8.5	15	1.3	4	*
Isodrin	617	1.0	102	8.9	22	6.8	4	*
Mirex	617	0.2	125	9.5	30	5.0	4	*
PCNB	617	0.01	70	4.3	15	2.8	4	*
Perthane	617	5.0	100	11.2	25	9.7	4	*
Strobane	617	2.0	73	18.8	26	10.0	4	*
Trifluralin	617	1.0	70	19.0	21	4.9	4	*
Chloropicrin	617	0.5	80	6.0	20	4.6	4	*

Parameter	EPA Method	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Ametryn	619	0.1	135	4.1	25	1.9	4	*
Atraton	619	5.0	126	9.3	25	1.9	4	*
Atrazine	619	0.1	130	6.5	16	7.9	4	*
Prometryn	619	0.1	86	7.2	21	10.3	4	*
Propazine	619	0.1	95	11.3	18	11.1	4	*
Secbumeton	619	5.0	87	15.0	30	9.4	4	*
Simetryn	619	0.1	76	20.0	22	8.3	4	*
Simazine	619	0.1	90	37.0	20	10.1	4	*
Terbutylazine	619	0.1	91	9.3	20	9.7	4	*
Terbutryn	619	0.1	99	40.0	20	10.0	4	*
Prometon	619	0.1	89	13.7	18	2.1	4	*
Azinphos methyl	622	2.0	75	10.3	20	12.0	4	*
Bolstar	622	0.2	122	12.2	15	7.3	4	*
Chloropyrifos	622	0.5	85	14.2	25	12.5	4	*
Chloropyrifos methyl	622	0.5	89	15.0	23	7.0	4	*
Coumaphos	622	2.0	90	9.8	27	6.0	4	*
Demeton	622	0.5	85	7.4	27	5.9	4	*
Diazinon	622	1.0	82	9.0	20	8.9	4	*
Dichlorvos	622	0.2	100	11.5	35	6.8	4	*
Disulfoton	622	0.5	91	7.6	15	4.5	4	*
Ethoprop	622	0.5	100	3.4	13	5.1	4	*
Fensulfothion	622	2.0	93	6.3	14	6.0	4	*
Fenthion	622	0.2	112	4.9	15	5.4	4	*
Merphos	622	0.5	77	6.5	15	4.2	4	*
Mevinphos	622	0.5	98	6.1	14	6.4	4	*

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Acetone	8240 (5030)	10	135	9.9	25	10.1	3	
Acetonitrile	8240 (5030)	10	116	8.1	27	14.1	3	
Acrolein	8240 (5030)	100	140	10.6	25	7.3	3	
Acrylonitrile	8240 (5030)	100	145	11.3	25	9.9	3	
Allyl Chloride	8240 (5030)	100	106	10.2	15	10.4	3	
Benzene	624/8240 (5030)	1	95	2.0	30	17.4	3,4	
Bromodichloromethane	624/8240 (5030)	1	103	15.8	15	5.9	3,4	
Bromoform	624/8240 (5030)	2	118	23.5	15	3.4	3,4	
Bromomethane	624/8240 (5030)	1	100	10.0	27	13.0	3,4	
2-Butanone (MEK)	8240 (5030)	3	131	20.0	30	14.0	3	
Carbon disulfide	8240 (5030)	1	119	18.2	27	15.1	3	
Carbon tetrachloride	624/8240 (5030)	2	110	16.8	12	2.5	3,4	
Chloroethane	624/8240 (5030)	1	121	16.9	17	6.1	3,4	
Chlorobenzene	624/8240 (5030)	1	98	22.8	16	9.0	3,4	
2-Chloroethyl vinyl ether	624/8240 (5030)	5	100	10.0	20	6.2	3,4	
Chloroform	624/8240 (5030)	2	93	3.3	16	2.2	3,4	
Chloromethane	624/8240 (5030)	2	113	18.1	27	21.4	3,4	
Chloropropene	8240 (5030)	2	95	2.0	15	9.1	3	
Chlorodibromoethane	624/8240 (5030)	5	101	3.0	17	1.8	3,4	
Dibromomethane	8240 (5030)	5	110	4.6	20	9.2	3	
1,4-Dichloro-2-butane	8240 (5030)	5	131	5.1	20	8.7	3	
Dichlorodifluoromethane	8240 (5030)	5	127	10.2	25	7.6	3	
1,2-Dichlorobenzene	624/8240 (5030)	2	94	4.5	22	14.5	3,4	
1,3-Dichlorobenzene	624/8240 (5030)	2	110	16.8	14	4.8	3,4	
1,4-Dichlorobenzene	624/8240 (5030)	2	95	4.5	22	14.5	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,1-Dichloroethane	624/8240 (5030)	1	105	3.6	13	5.0	3,4	
1,2-Dichloroethane	624/8240 (5030)	2	102	4.5	17	3.2	3,4	
1,2-Dichloroethene (total)	8240 (5030)	5	130	10.0	25	7.2	3	
1,1-Dichloroethene	624/8240 (5030)	1	112	6.1	17	10.6	3,4	
1,2-Dichloropropane	624/8240 (5030)	2	100	10.0	25	3.0	3,4	
cis-1,3-Dichloropropene	624/8240 (5030)	1	100	10.0	23	8.0	3,4	
trans-1,3-Dichloropropene	624/8240 (5030)	1	100	10.0	25	5.0	3,4	
Ethanol	8240 (5030)	50	110	9.9	20	7.8	3	
Ethylbenzene	624/8240 (5030)	1	98	24.8	14	10.0	3,4	
Ethyl methacrylate	8240 (5030)	5	111	3.9	20	7.9	3	
Methyl methacrylate	8240 (5030)	5	76	6.1	21	5.2	3	
Pentachloroethane	8240 (5030)	5	100	11.5	35	6.8	3	
Propionitrile	8240 (5030)	5	109	9.0	25	8.1	3	
Pyridine	8240 (5030)	5	80	15.8	27	4.5	3	
2-Hexanone	8240 (5030)	3	140	8.7	21	8.1	3	
Iodomethane	8240 (5030)	5	136	7.4	25	5.7	3	
Isobutyl alcohol	8240 (5030)	5	113	5.1	21	5.6	3	
Methyl Bromide	8240 (5030)	3	106	2.0	13	2.0	3	
Methyl Chloride	8240 (5030)	3	108	3.1	10	2.5	3	
Methylene Bromide	8240 (5030)	3	106	5.5	17	4.1	3	
Methylene chloride	624/8240 (5030)	3	87	18.8	15	10.7	3,4	
Methyl Iodine	8240 (5030)	3	92	3.3	10	7.3	3	
1,4-Dioxane	8240 (5030)	3	98	8.8	18	11.7	3	
4-Methyl-2-pentanone	8240 (5030)	3	90	6.1	20	11.7	3	
Styrene	8240 (5030)	2	95	12.2	27	10.8	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,1,1,2-Tetrachloroethane	8240 (5030)	2	109	13.0	20	7.0	3	
1,1,2,2-Tetrachloroethane	624/8240 (5030)	2	93	17.6	16	6.9	3,4	
Tetrachloroethene	624/8240 (5030)	1	106	6.0	13	1.8	3,4	
Toluene	624/8240 (5030)	1	98	2.3	15	7.1	3,4	
Trans-1,4-Dichloro-2-Butene	8240 (5030)	1	97	3.7	11	3.0	3	
1,1,1-Trichloroethane	624/8240 (5030)	5	106	7.3	12	1.5	3,4	
1,1,2-Trichloroethane	624/8240 (5030)	2	95	17.1	14	2.0	3,4	
Trichloroethene	624/8240 (5030)	1	104	22.7	13	3.6	3,4	
Trichlorofluoromethane	624/8240 (5030)	1	99	3.9	28	15.0	3,4	
1,2,3-Trichloropropane	8240 (5030)	5	131	4.7	27	15.1	3	
Vinyl acetate	8240 (5030)	2	129	5.0	25	16.2	3	
Vinyl chloride	624/8240 (5030)	1	100	10.0	30	18.0	3,4	
Xylenes	624/8240 (5030)	4	115	11.0	12	9.0	3,4	
Acenaphthene	625/8270 (3510)	10	110	9.2	12	1.7	3,4	
	(3520)	10	96	19.0	15	12.0	3,4	
Acenaphthylene	625/8270 (3510)	10	100	4.0	10	4.1	3,4	
	(3520)	10	89	7.4	25	10.6	3,4	
Acetophenone	8270 (3510)	10	105	10.1	20	7.6	3	
	(3520)	10	90	13.0	20	11.0	3	
2-Acetylaminofluorene	8270 (3510)	10	95	5.9	19	5.1	3	
	(3520)	10	75	14.4	21	12.9	3	
Aldrin	625/8270 (3510)	10	99	6.7	13	6.6	3,4	
	(3520)	10	78	16.6	27	12.8	3,4	
4-Aminobiphenyl	8270 (3510)	10	103	16.6	18	7.3	3	
	(3520)	10	70	17.1	30	13.8	3	
Aniline	8270 (3510)	10	109	4.9	19	5.1	3	
	(3520)	10	70	7.6	21	14.0	3	
Anthracene	625/8270 (3510)	10	81	5.1	11	2.2	3,4	
	(3520)	10	80	6.8	20	13.2	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Aramite	8270 (3510)	10	97	2.8	13	5.0	3	
	(3520)	10	73	8.1	22	15.0	3	
Benzidine	625/8270 (3510)	80	103	2.0	14	1.1	3,4	
	(3520)	80	75	10.2	25	17.0	3,4	
Benzo(a)anthracene	625/8270 (3510)	80	98	3.2	12	2.3	3,4	
	(3520)	80	75	10.2	28	17.0	3,4	
Benzo(b)fluoranthene	625/8270 (3510)	80	99	1.0	12	3.0	3,4	
	(3520)	80	75	10.2	25	17.0	3,4	
Benzo(k)fluorathene	625/8270 (3510)	80	104	3.4	16	5.4	3,4	
	(3520)	80	75	10.2	28	17.0	3,4	
Benzo(ghi)perylene	625/8270 (3510)	80	98	8.3	12	1.1	3,4	
	(3520)	80	75	10.2	26	17.0	3,4	
Benzo(a)pyrene	625/8270 (3510)	80	98	8.3	15	6.4	3,4	
	(3520)	80	75	10.2	32	17.0	3,4	
Benzyl alcohol	625/8270 (3510)	80	100	2.4	12	3.4	3,4	
	(3520)	80	75	10.2	27	17.0	3,4	
Bis(2-Chloro-1-methyl-ethyl ether	625/8270 (3510)	80	89	5.9	10	1.1	3,4	
	(3520)	80	75	10.2	14	17.0	3,4	
delta-BHC	625/8270 (3510)	10	103	3.8	15	5.8	3,4	
	(3520)	10	91	10.3	37	18.1	3,4	
gamma-BHC	625/8270 (3510)	10	89	12.1	12	2.1	3,4	
	(3520)	10	91	11.0	25	18.2	3,4	
Bis(2-chloroethoxy)methane	625/8270 (3510)	10	85	15.0	20	2.9	3,4	
	(3520)	10	112	15.4	16	13.4	3,4	
Bis(2-chloroethyl)ether	625/8270 (3510)	10	80	11.3	23	13.7	3,4	
	(3520)	10	86	15.4	30	9.9	3,4	
Bis(2-chloroisopropyl)ether	625/8270 (3510)	10	93	5.2	28	6.0	3,4	
	(3520)	10	103	23.1	24	2.8	3,4	
Bis(2-ethylhexyl)phthalate	625/8270 (3510)	10	73	8.3	21	5.1	3,4	
	(3520)	10	89	11.8	26	7.3	3,4	
4-Bromophenyl phenyl ether	625/8270 (3510)	10	96	3.6	20	7.6	3,4	
	(3520)	10	91	13.4	13	6.6	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Butyl benzyl phthalate	625/8270 (3510)	10	81	5.0	12	4.6	3,4	
	(3520)	10	95	2.0	15	7.1	3,4	
Chlordane	625/8270 (3510)	10	91	10.7	13	9.1	3,4	
	(3520)	10	90	2.1	16	8.9	3,4	
p-Chloroaniline	8270 (3510)	20	120	15.0	20	6.1	3	
	(3520)	20	85	2.5	20	9.0	3	
Chlorobenzilate	8270 (3510)	10	93	5.2	22	5.3	3	
	(3520)	10	86	2.5	19	10.0	3	
4-Chloro-3-methylphenol (p-chloro-m-cresol)	625/8270 (3510)	10	93	6.5	15	4.6	3,4	
	(3520)	10	84	3.5	23	7.5	3,4	
1-Chloronaphthalene	8270 (3510)	10	92	5.7	21	5.6	3	
	(3520)	10	85	3.1	20	7.6	3	
2-Chloronaphthalene	625/8270 (3510)	10	91	6.0	21	6.1	3,4	
	(3520)	10	89	2.9	21	8.7	3,4	
2-Chlorophenol	625/8270 (3510)	20	86	3.0	25	4.7	3,4	
	(3520)	20	90	2.9	23	9.0	3,4	
4-Chlorophenylphenyl ether	625/8270 (3510)	10	104	7.0	17	9.0	3,4	
	(3520)	10	91	5.3	20	9.4	3,4	
Chrysene	625/8270 (3510)	10	95	19.0	21	4.6	3,4	
	(3520)	10	93	10.0	28	13.0	3,4	
2-Methylphenol(o-cresol)	8270 (3510)	10	114	4.6	20	4.5	3	
	(3520)	10	94	10.1	25	1.3	3	
4-Methylphenol(p-cresol)	8270 (3510)	10	112	11.0	21	9.3	3	
	(3520)	10	95	11.1	26	9.1	3	
3-Methylphenol (m-cresol)	8270 (3510)	10	98	15.0	20	3.9	3	
	(3520)	10	79	8.0	21	4.1	3	
4,4'-DDD	625/8270 (3510)	10	99	15.0	14	6.3	3,4	
	(3520)	10	56	4.0	20	3.2	3,4	
4,4'-DDE	625/8270 (3510)	10	94	17.0	26	11.0	3,4	
	(3520)	10	70	5.4	26	11.7	3,4	
4,4'-DDT	625/8270 (3510)	10	77	12.0	13	6.7	3,4	
	(3520)	10	79	3.3	35	19.0	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Diallate	625/8270 (3510)	10	91	11.6	15	5.0	3,4	
	(3520)	10	64	6.0	20	9.0	3,4	
Dibenzo(a,h)anthracene	625/8270 (3510)	10	112	12.2	15	10.1	3,4	
	(3520)	10	88	4.7	18	8.5	3,4	
Dibenzofuran	625/8270 (3510)	10	98	10.0	16	1.1	3,4	
	(3520)	10	73	5.0	20	2.0	3,4	
Di-n-butyl phthalate	625/8270 (3510)	10	99	15.9	11	8.3	3,4	
	(3520)	10	60	7.1	13	11.6	3,4	
1,2-Dichlorobenzene	625/8270 (3510)	10	89	6.0	12	7.0	3,4	
	(3520)	10	80	2.8	20	4.7	3,4	
1,3-Dichlorobenzene	625/8270 (3510)	10	100	1.8	15	9.4	3,4	
	(3520)	10	86	7.0	25	6.8	3,4	
1,4-Dichlorobenzene	625/8270 (3510)	10	91	11.6	15	2.8	3,4	
	(3520)	10	73	14.7	24	2.3	3,4	
3,3'-Dichlorobenzidine	625/8270 (3510)	10	99	1.6	15	5.3	3,4	
	(3520)	10	120	12.6	28	7.3	3,4	
2,4-Dichlorophenol	625/8270 (3510)	10	107	2.7	13	6.6	3,4	
	(3520)	10	87	1.3	15	1.3	3,4	
2,6-Dichlorophenol	8270 (3510)	10	93	2.3	12	1.9	3	
	(3520)	10	75	5.0	15	3.4	3	
Dieldrin	625/8270 (3510)	10	100	3.3	12	6.1	3,4	
	(3520)	10	82	1.6	20	1.6	3,4	
Diethyl phthalate	625/8270 (3510)	10	96	4.3	10	5.4	3,4	
	(3520)	10	100	10.4	19	14.4	3,4	
Dimethoate	8270 (3510)	10	100	3.4	10	6.0	3	
	(3520)	10	90	3.4	20	5.4	3	
p-(Dimethylamino)azobenzene	8270 (3510)	10	96	2.4	15	5.6	3	
	(3520)	10	80	5.6	21	5.0	3	
7,12-Dimethylbenz(a)anthracene	8270 (3510)	10	98	6.8	10	3.7	3	
	(3520)	10	73	1.1	25	6.2	3	
3,3'-Dimethylbenzidine	8270 (3510)	10	98	2.4	15	2.6	3	
	(3520)	10	64	3.9	20	6.7	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
alpha,alpha-Dimethyl phenethylamine	8270 (3510) (3520)	10 10	97 74	2.7 4.0	15 24	6.1 6.1	3 3	
2,4-Dimethylphenol	625/8270 (3510) (3520)	10 10	99 75	1.7 5.3	10 21	5.4 9.0	3,4 3,4	
4,6-Dinitro-O-Cresol	8270 (3510) (3520)	10 10	106 86	5.5 2.6	17 21	4.1 6.2	3 3	
Dimethyl phthalate	625/8270 (3510) (3520)	10 10	100 75	4.4 5.0	12 22	5.1 8.7	3,4 3,4	
m-Dinitrobenzene	8270 (3510) (3520)	10 10	98 75	2.5 7.0	12 26	5.6 10.1	3 3	
4,6-Dinitro-2-methylphenol	625/8270 (3510) (3520)	50 50	96 76	3.8 3.9	12 30	5.1 11.3	3,4 3,4	
2,4-Dinitrophenol	625/8270 (3510) (3520)	50 50	106 79	5.5 9.9	17 29	4.1 10.2	3,4 3,4	
2,4-Dinitrotoluene	625/8270 (3510) (3520)	10 10	114 101	1.1 10.1	12 25	2.6 10.0	3,4 3,4	
2,6-Dinitrotoluene	625/8270 (3510) (3520)	10 10	99 112	1.2 11.1	10 26	1.9 11.0	3,4 3,4	
Dinoseb	8270 (3510) (3520)	50 50	97 90	3.7 11.0	11 27	3.0 12.3	3 3	
Di-n-octyl phthalate	625/8270 (3510) (3520)	10 10	97 91	2.7 12.0	15 15	6.1 15.1	3,4 3,4	
Diphenylamine (N-Nitroso- diphenylamine)	625/8270 (3510) (3520)	10 10	104 92	1.7 13.0	13 25	2.0 19.0	3,4 3,4	
1,2-Diphenylhydrazine	8270 (3510) (3520)	10 10	103 90	3.8 14.1	15 25	5.8 17.3	3 3	
Disulfoton	8270 (3510) (3520)	10 10	98 97	9.0 6.1	12 15	2.0 2.9	3 3	
Endosulfan I	625/8270 (3510) (3520)	10 10	99 60	2.3 5.2	16 13	5.9 9.1	3,4 3,4	
Endosulfan II	625/8270 (3510) (3520)	10 10	98 65	2.4 6.2	12 30	6.0 8.4	3,4 3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Endosulfan sulfate	625/8270 (3510)	10	99	6.7	13	6.6	3,4	
	(3520)	10	73	7.0	25	7.6	3,4	
Endrin	625/8270 (3510)	10	100	4.8	11	5.6	3,4	
	(3520)	10	75	8.3	20	3.9	3,4	
Endrin aldehyde	625/8270 (3510)	10	100	4.9	21	7.0	3,4	
	(3520)	10	76	9.8	22	4.0	3,4	
Endrin ketone	8270 (3510)	10	81	1.3	20	6.0	3	
	(3520)	10	77	9.3	26	5.7	3	
Ethyl methacrylate	8270 (3510)	10	95	5.9	19	5.1	3	
	(3520)	10	80	5.5	23	7.7	3	
Ethyl methane sulfonate	8270 (3510)	10	109	6.7	17	4.7	3	
	(3520)	10	85	7.4	24	8.9	3	
Ethyl parathion	8270 (3510)	10	97	5.2	16	4.2	3	
	(3520)	10	75	7.9	20	6.1	3	
Famphur	8270 (3510)	10	107	10.3	13	3.5	3	
	(3520)	10	76	9.0	25	5.0	3	
Fluoranthene	625/8270 (3510)	10	110	9.2	12	1.7	3,4	
	(3520)	10	77	10.1	25	5.0	3,4	
Fluorene	625/8270 (3510)	10	109	6.0	11	1.0	3,4	
	(3520)	10	91	11.1	19	3.9	3,4	
Heptachlor	625/8270 (3510)	10	104	13.1	10	6.2	3,4	
	(3520)	10	87	3.9	30	4.7	3,4	
Heptachlor epoxide	625/8270 (3510)	10	107	12.0	20	6.7	3,4	
	(3520)	10	85	5.4	23	6.1	3,4	
Hexachlorobenzene	625/8270 (3510)	10	105	10.1	20	7.6	3,4	
	(3520)	10	87	6.9	18	7.8	3,4	
Hexachlorobutadiene	625/8270 (3510)	10	103	16.6	18	7.3	3,4	
	(3520)	10	96	6.3	20	6.7	3,4	
Hexachlorocyclopentadiene	8270 (3510)	10	100	3.8	16	1.6	3	
	(3520)	10	89	2.9	28	5.4	3	
Hexachloroethane	625/8270 (3510)	10	98	6.1	15	3.9	3,4	
	(3520)	10	78	5.0	18	1.7	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Hexachloropropene	8270 (3510)	10	91	11.6	15	5.0	3	
	(3520)	10	80	5.2	26	1.4	3	
Indeno(1,2,3-cd)pyrene	625/8270 (3510)	10	88	9.8	15	2.8	3,4	
	(3520)	10	88	6.5	26	5.8	3,4	
Isodrin	8270 (3510)	10	102	6.1	15	2.6	3	
	(3520)	10	99	4.7	15	2.5	3	
Isophorone	625/8270 (3510)	10	100	1.8	15	9.4	3,4	
	(3520)	10	93	5.2	28	6.0	3,4	
Isosafrole	8270 (3510)	10	112	12.2	15	10.1	3	
	(3520)	10	66	10.5	26	3.6	3	
Kepone	8270 (3510)	10	100	3.4	10	5.6	3	
	(3520)	10	87	2.6	17	9.2	3	
Methapyrilene	8270 (3510)	10	96	4.0	10	5.7	3	
	(3520)	10	70	3.6	28	1.5	3	
Methoxychlor	8270 (3510)	10	97	5.0	10	5.4	3	
	(3520)	10	79	3.0	26	6.2	3	
3-Methylchloanthrene	8270 (3510)	10	114	16.6	11	5.7	3	
	(3520)	10	80	10.1	17	6.0	3	
Methyl methanesulfonate	8270 (3510)	10	89	6.0	12	7.0	3	
	(3520)	10	86	9.0	19	6.1	3	
2-Methylnaphthalene	8270 (3510)	10	107	2.7	13	6.6	3	
	(3520)	10	73	7.3	17	6.4	3	
1-Methylnaphthalene	8270 (3510)	10	100	3.3	12	6.1	3	
	(3520)	10	76	6.1	21	5.2	3	
Methyl parathion	8270 (3510)	10	99	15.9	11	8.3	3	
	(3520)	10	81	9.9	28	4.9	3	
Naphthalene	625/8270 (3510)	10	104	2.4	16	3.9	3,4	
	(3520)	10	135	4.1	25	1.9	3,4	
1,4-Napthoquinone	8270 (3510)	10	99	1.6	15	5.3	3	
	(3520)	10	130	6.9	23	10.2	3	
1-Napthylamine	8270 (3510)	10	98	2.4	15	5.6	3	
	(3520)	10	153	9.1	20	3.4	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/L)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
2-Napthylamine	8270 (3510)	10	98	2.4	15	5.6	3	
	(3520)	10	126	9.3	25	1.9	3	
o-Nitroaniline	8270 (3510)	10	96	11.0	15	5.4	3	
	(3520)	10	160	9.4	26	6.4	3	
m-Nitroaniline	8270 (3510)	50	96	7.0	15	7.6	3	
	(3520)	50	110	2.2	30	5.6	3	
p-Nitroaniline	8270 (3510)	50	98	10.0	16	1.1	3	
	(3520)	50	149	12.0	16	7.2	3	
Nitrobenzene	625/8270 (3510)	10	97	5.6	13	2.6	3,4	
	(3520)	10	125	10.1	20	7.4	3,4	
2-Nitrophenol	625/8270 (3510)	10	97	2.3	12	1.9	3,4	
	(3520)	10	112	8.7	20	7.7	3,4	
4-Nitrophenol	625/8270 (3510)	50	93	11.7	12	3.0	3,4	
	(3520)	50	130	6.5	16	7.9	3,4	
4-Nitroquinoline-1-oxide	8270 (3510)	10	98	6.8	10	3.7	3	
	(3520)	10	118	4.2	25	8.1	3	
N-Nitroso-di-n-butylamine	8270 (3510)	10	101	4.0	11	4.1	3	
	(3520)	10	112	5.0	24	2.9	3	
N-Nitroso-diethylamine	8270 (3510)	10	113	5.4	15	4.2	3	
	(3520)	10	90	5.1	26	9.0	3	
N-Nitroso-di-methylamine	625/8270 (3510)	10	113	5.4	15	4.2	3,4	
	(3520)	10	91	6.1	16	10.1	3,4	
N-Nitroso-di-phenylamine	625/8270 (3510)	10	90	6.1	12	3.6	3,4	
	(3520)	10	86	7.2	21	10.3	3,4	
N-Nitroso-di-n-propylamine	625/8270 (3510)	10	90	6.1	12	3.6	3,4	
	(3520)	10	81	7.3	22	7.5	3,4	
N-Nitrosomethylethylamine	8270 (3510)	10	103	5.1	12	3.2	3	
	(3520)	10	140	9.0	30	4.5	3	
N-Nitrosomorpholine	8270 (3510)	10	129	5.0	25	16.2	3	
	(3520)	10	117	3.4	30	3.5	3	
N-Nitrosopiperidine	8270 (3510)	10	99	3.9	28	15.0	3	
	(3520)	10	106	12.1	22	4.4	3	
N-Nitrosopyrrolidine	8270 (3510)	10	93	17.6	16	6.9	3	
	(3520)	10	91	9.3	20	9.7	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
5-Nitro-o-toluidine	8270 (3510)	10	98	8.7	29	4.0	3	
	(3520)	10	95	10.1	19	10.3	3	
PCB-1016	625/8270 (3510)	100	95	10.8	14	9.4	3,4	
	(3520)	100	95	11.3	18	11.1	3,4	
PCB-1221	625/8270 (3510)	100	93	19.0	20	2.4	3,4	
	(3520)	100	94	12.9	37	9.7	3,4	
PCB-1232	625/8270 (3510)	100	95	14.0	23	2.3	3,4	
	(3520)	100	90	13.4	40	10.1	3,4	
PCB-1242	625/8270 (3510)	100	93	17.0	13	6.0	3,4	
	(3520)	100	87	15.0	30	9.4	3,4	
PCB-1248	625/8270 (3510)	100	96	7.0	26	11.0	3,4	
	(3520)	100	89	17.0	25	3.5	3,4	
PCB-1254	625/8270 (3510)	100	99	13.0	25	6.0	3,4	
	(3520)	100	93	18.0	24	4.9	3,4	
PCB-1260	625/8270 (3510)	100	101	5.0	16	4.8	3,4	
	(3520)	100	89	19.0	22	7.1	3,4	
Pentachlorobenzene	8270 (3510)	10	93	6.5	15	4.6	3	
	(3520)	10	76	20.0	22	8.3	3	
Pentachloroethane	8270 (3510)	10	94	3.1	21	5.9	3	
	(3520)	10	87	21.0	23	9.0	3	
Pentachloronitrobenzene	8270 (3510)	10	96	4.0	19	4.1	3	
	(3520)	10	90	37.0	20	10.0	3	
Pentachlorophenol	625/8270 (3510)	50	96	5.2	22	5.3	3,4	
	(3520)	50	99	40.0	20	10.0	3,4	
Phenacetin	8270 (3510)	100	93	5.2	22	5.3	3	
	(3520)	100	122	12.2	15	7.3	3	
Phenanthrene	625/8270 (3510)	10	95	10.0	17	1.7	3,4	
	(3520)	10	115	12.1	12	4.0	3,4	
Phenol	625/8270 (3510)	10	92	5.7	21	5.6	3,4	
	(3520)	10	113	11.3	19	3.7	3,4	
p-Phenylenediamine	8270 (3510)	10	92	5.7	21	5.6	3	
	(3520)	10	89	13.7	18	2.1	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/L)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Phorate	8270 (3510) (3520)	10 10	90 85	15.2 12.0	30 20	7.0 14.0	3 3	
2-Picoline	8270 (3510) (3520)	10 10	109 73	16.1 11.5	29 20	6.6 13.7	3 3	
Pronamide	8270 (3510) (3520)	10 10	80 75	15.8 10.3	27 20	4.5 12.0	3 3	
Pyrene	625/8270 (3510) (3520)	10 10	62 89	16.0 15.0	30 23	8.9 7.0	3,4 3,4	
Pyridine	8270 (3510) (3520)	10 10	83 85	4.8 15.0	18 19	6.2 6.3	3 3	
Safrole	8270 (3510) (3520)	10 10	87 80	1.2 12.5	16 23	1.4 7.3	3 3	
Sulfotepp	8270 (3510) (3520)	10 10	83 81	8.4 13.0	21 27	7.5 8.4	3 3	
1,2,4,5-Tetrachlorobenzene	8270 (3510) (3520)	10 10	67 80	11.0 11.3	12 27	7.1 7.3	3 3	
2,3,4,6-Tetrachlorophenol	8270 (3510) (3520)	10 10	80 85	17.0 14.2	9 25	6.6 12.5	3 3	
o-Toluidine	8270 (3510) (3520)	10 10	69 85	19.0 13.7	11 25	5.6 13.0	3 3	
Thionazin	8270 (3510) (3520)	10 10	71 85	11.0 14.4	12 26	3.4 17.0	3 3	
Toxaphene	625/8270 (3510) (3520)	200 200	66 101	4.7 10.1	10 30	1.0 7.0	3,4 3,4	
1,2,4-Trichlorobenzene	625/8270 (3510) (3520)	10 10	97 90	10.6 9.8	12 27	6.1 6.0	3,4 3,4	
2,4,5-Trichlorophenol	8270 (3510) (3520)	10 10	93 89	7.0 7.3	11 22	3.2 6.3	3 3	
2,4,6-Trichlorophenol	625/8270 (3510) (3520)	10 10	91 85	10.7 7.4	13 27	9.1 5.9	3,4 3,4	
1,3,5-Trinitrobenzene	8270 (3510) (3520)	10 10	96 85	6.5 6.0	11 37	1.0 6.7	3 3	

Parameter	EPA Method (Prep)	Detection Limit(ug/L)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
O,O,O-Triethylphosphorothiate	8270 (3510)	10	67	10.5	18	5.8	3	
	(3520)	10	85	6.0	20	6.7	3	
SYM-Trinitrobenzene	8270 (3510)	10	95	8.5	20	4.6	3	
	(3520)	10	85	6.0	35	6.7	3	
Petroleum Fingerprint	Modified 8015	10	75	5.0	25	5.3	3	
2-Chloronaphthalene	612/8120 (3510)	1.0	95	8.5	20	4.6	3,4	
	(3520)	1.0	100	11.5	35	6.8	3,4	
1,2-Dichlorobenzene	612/8120 (3510)	1.0	80	6.0	29	7.0	3,4	
	(3520)	1.0	67	6.0	11	5.4	3,4	
1,3-Dichlorobenzene	612/8120 (3510)	1.0	108	5.2	40	11.2	3,4	
	(3520)	1.0	72	7.7	13	1.5	3,4	
1,4-Dichlorobenzene	612/8120 (3510)	1.0	98	7.9	25	8.0	3,4	
	(3520)	1.0	82	9.0	20	8.9	3,4	
Hexachlorobenzene	612/8120 (3510)	1.0	100	11.2	25	9.7	3,4	
	(3520)	1.0	98	5.5	20	10.0	3,4	
Hexachlorobutadiene	612/8120 (3510)	1.0	75	7.0	22	6.0	3,4	
	(3520)	1.0	101	4.1	25	11.0	3,4	
Hexachlorocyclopentadiene	612/8120 (3510)	1.0	70	4.3	15	2.8	3,4	
	(3520)	1.0	94	17.1	30	14.8	3,4	
Hexachloroethane	612/8120 (3510)	1.0	77	18.0	16	7.0	3,4	
	(3520)	1.0	69	19.9	22	5.9	3,4	
1,2,4-Trichlorobenzene	612/8120 (3510)	1.0	64	10.0	13	4.3	3,4	
	(3520)	1.0	98	11.0	30	4.4	3,4	

ORGANIC PARAMETER METHODS
 ACCURACY, PRECISION, DETECTION LIMITS AND COMPLETENESS DATA
 FOR SOIL, SLUDGE AND OTHER SEDIMENTS

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Benzyl chloride	8010 (5030)	5	97	3.6	15	4.3	3	
Bis(2-chloroethoxy)methane	8010 (5030)	5	89	7.0	14	4.7	3	
Bis(2-chloroisopropyl)ether	8010 (5030)	5	87	4.8	11	7.6	3	
Bromobenzene	8010 (5030)	5	86	3.0	13	5.6	3	
Bromodichloromethane	8010 (5030)	5	90	1.7	14	5.0	3	
Bromoform	8010 (5030)	5	94	1.5	15	4.4	3	
Bromomethane	8010 (5030)	5	95	5.0	12	8.3	3	
Carbon tetrachloride	8010 (5030)	5	91	7.6	15	4.5	3	
Chloroacetaldehyde	8010 (5030)	25	100	6.3	12	3.2	3	
Chlorobenzene	8010 (5030)	5	100	3.4	13	5.1	3	
Chloroethane	8010 (5030)	5	97	4.0	14	5.2	3	
Chloroform	8010 (5030)	5	98	6.1	14	6.4	3	
1-Chlorohexane	8010 (5030)	5	104	6.2	14	7.3	3	
2-Chloroethylvinyl ether	8010 (5030)	5	95	6.9	13	4.0	3	
Chloromethane	8010 (5030)	5	93	6.0	14	5.4	3	
Chloromethylmethyl ether	8010 (5030)	25	95	6.0	15	4.9	3	
Chlorotoluene	8010 (5030)	5	93	6.1	15	5.3	3	
Dibromochloromethane	8010 (5030)	5	77	6.5	15	4.2	3	
Dibromomethane	8010 (5030)	5	93	6.3	14	6.0	3	
1,2-Dichlorobenzene	8010 (5030)	5	100	5.3	14	5.7	3	
1,3-Dichlorobenzene	8010 (5030)	5	99	4.7	15	3.9	3	
1,4-Dichlorobenzene	8010 (5030)	5	97	3.9	15	4.9	3	
Dichlorodifluoromethane	8010 (5030)	5	112	4.9	15	5.4	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,1-Dichloroethane	8010 (5030)	5	127	8.2	14	8.1	3	
1,2-Dichloroethane	8010 (5030)	5	126	7.4	15	10.8	3	
1,1-Dichloroethylene	8010 (5030)	5	124	9.2	16	7.0	3	
1,2-Dichloroethene	8010 (5030)	5	130	9.6	17	6.2	3	
Methylene Chloride	8010 (5030)	5	120	6.6	18	6.2	3	
1,2-Dichloropropane	8010 (5030)	5	120	6.2	14	3.5	3	
1,3-Dichloropropylene	8010 (5030)	5	125	13.0	16	9.6	3	
1,1,2,2-Tetrachloroethane	8010 (5030)	5	127	11.2	18	10.8	3	
1,1,1,2-Tetrachloroethane	8010 (5030)	5	112	6.2	19	11.1	3	
Tetrachloroethylene	8010 (5030)	5	115	7.7	20	1.7	3	
1,1,1-Trichloroethane	8010 (5030)	5	137	11.3	21	12.4	3	
1,1,2-Trichloroethane	8010 (5030)	5	130	12.4	23	11.8	3	
Trichloroethylene	8010 (5030)	5	112	7.0	27	5.0	3	
Trichlorofluoromethane	8010 (5030)	5	110	6.6	26	7.9	3	
Trichloropropane	8010 (5030)	5	97	11.4	19	12.6	3	
Vinyl Chloride	8010 (5030)	5	99	10.2	20	13.6	3	
1,2-Dibromoethane (EDB)	8010 (5030)	5	10	10	10	10	3	
Benzene	8020 (5030)	5	120	4.1	15	7.9	3	
Chlorobenzene	8020 (5030)	5	110	3.5	16	5.4	3	
1,2-Dichlorobenzene	8020 (5030)	5	112	5.8	17	6.8	3	
1,3-Dichlorobenzene	8020 (5030)	5	101	4.0	13	7.6	3	
1,4-Dichlorobenzene	8020 (5030)	5	99	6.7	14	5.5	3	
Ethylbenzene	8020 (5030)	5	98	5.5	15	8.2	3	
Toluene	8020 (5030)	5	99	10.0	19	7.7	3	
Xylenes	8020 (5030)	5	97	10.6	20	3.2	3	

- Can be analyzed by 8010 substituting a Halls Detector with an E. C. Detector.

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Acrolein	8030 (5030)	250	101	11.6	11	5.5	3	
Acrylonitrile	8030 (5030)	250	110	12.8	10	3.9	3	
Acetonitrile	8030 (5030)	250	109	12.7	15	4.1	3	
Petroleum Fingerprint	Modified 8015	10	120	6.1	20	7.3	3	
Acrylamide	8015 (5030)	5	127	19.0	30	3.4	3	
2-Butanone (MEK)	8015 (5030)	5	130	18.0	30	6.5	3	
Diethyl ether	8015 (5030)	5	126	16.0	30	2.4	3	
Ethanol	8015 (5030)	5	125	24.0	31	8.4	3	
Ethyl methacrylate	8015 (5030)	5	120	21.0	31	7.3	3	
Isobutyl alcohol	8015 (5030)	5	118	23.0	37	8.1	3	
Isopropyl alcohol	8015 (5030)	5	115	31.0	31	7.6	3	
Methacrylonitrile	8015 (5030)	5	110	26.0	30	7.3	3	
Methyl methacrylate	8015 (5030)	5	126	25.0	23	9.0	3	
4-Methyl-2-pentanone	8015 (5030)	5	121	19.0	26	3.4	3	
Methyl-tert-butyl ether(MTBE)	8015 (5030)	5	131	15.0	21	4.0	3	
Paraldehyde	8015 (5030)	5	96	7.7	35	12.0	3	
Propionitrile	8015 (5030)	5	97	5.7	25	11.7	3	
2-Chlorophenol	8040 (3550)	100	96	2.0	25	6.7	3	
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	8040 (3550)	100	127	6.7	25	6.1	3	
2,4-Dichlorophenol	8040 (3550)	100	125	6.5	30	11.3	3	
2,4-Dimethylphenol	8040 (3550)	100	130	3.2	30	10.0	3	
2,4-Dinitrophenol	8040 (3550)	100	132	1.4	29	9.3	3	
2-Methyl-4,6-dinitrophenol	8040 (3550)	100	140	6.3	25	8.0	3	
2-Nitrophenol	8040 (3550)	100	100	9.0	35	2.9	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
4-Nitrophenol	8040 (3550)	100	97	5.7	25	11.7	3	
Pentachlorophenol	8040 (3550)	100	100	7.6	25	10.3	3	
Phenol	8040 (3550)	100	89	8.0	25	9.9	3	
Tetrachlorophenol	8040 (3550)	100	96	2.0	25	6.7	3	
2,4,6-Trichlorophenol	8040 (3550)	100	125	7.1	31	13.0	3	
Butyl benzyl phthalate	8060 (3550)	100	122	8.1	27	12.3	3	
Bis(2-ethylhexyl)phthalate	8060 (3550)	100	116	8.9	26	11.2	3	
Di-n-Butyl phthalate	8060 (3550)	100	123	3.4	24	10.0	3	
Diethyl phthalate	8060 (3550)	100	116	2.0	24	7.6	3	
Dimethyl phthalate	8060 (3550)	100	128	2.5	22	9.3	3	
Di-n-octyl phthalate	8060 (3550)	100	126	4.0	20	12.0	3	
Aldrin	8080 (3550)	2.5	108	2.2	16	1.4	3	
Alpha-BHC	8080 (3550)	2.0	98	2.4	16	2.0	3	
beta-BHC	8080 (3550)	4.0	78	4.3	25	2.1	3	
gamma-BHC (Lindane)	8080 (3550)	2.0	86	2.6	17	1.5	3	
delta-BHC	8080 (3550)	2.0	108	5.6	19	1.5	3	
Chlordane	8080 (3550)	10	113	5.1	20	1.3	3	
4,4'-DDD	8080 (3550)	5.0	122	7.0	20	9.6	3	
4,4'-DDE	8080 (3550)	5.0	134	6.0	18	7.3	3	
4,4'-DDT	8080 (3550)	10	147	5.3	20	6.4	3	
Dieldrin	8080 (3550)	5.0	119	5.4	21	5.6	3	
Endosulfan I	8080 (3550)	5.0	111	6.1	25	5.0	3	
Endosulfan II	8080 (3550)	10	126	7.7	25	5.1	3	
Endosulfan sulfate	8080 (3550)	15	150	2.2	27	4.5	3	
Endrin	8080 (3550)	5.0	100	3.5	29	6.1	3	

Parameter	EPA Method (Prep)	Detection Limit (ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Acrolein	603/8030 (5030)	50	104	2.0	25	6.1	3,4	
Acrylonitrile	603/8030 (5030)	50	84	6.0	25	7.1	3,4	
Acetonitrile	8030 (5030)	1000	109	9.0	25	8.1	3	
2-Butanone (MEK)	8015 (5030)	10	102	2.6	10	3.2	3	*
Diethyl ether	8015 (5030)	100	68	8.2	26	6.0	3	*
1,4-Dioxane	8015 (5030)	150	110	6.7	9	3.6	3	*
Ethanol	8015 (5030)	200	100	5.2	12	1.8	3	*
Ethyl methacrylate	8015 (5030)	10	99	7.2	8	6.2	3	*
Isobutyl alcohol	8015 (5030)	100	85	6.9	14	1.9	3	*
Isopropyl alcohol	8015 (5030)	100	92	3.8	11	4.1	3	*
Methacrylonitrile	8015 (5030)	100	102	6.5	10	3.4	3	*
Methanol	8015 (5030)	1000	108	3.4	8	1.6	3	
Methyl methacrylate	8015 (5030)	10	113	2.6	16	5.3	3	*
4-Methyl-2-pentanone (MIBK)	8015 (5030)	100	83	9.1	12	3.8	3	*
Methyl-tert-butyl ether (MTBE)	8015 (5030)	10	125	3.1	9	4.3	3	*
Paraldehyde	8015 (5030)	200	89	6.1	13	3.2	3	*
Propionitrile	8015 (5030)	100	92	2.9	7	6.3	3	*
2-Chlorophenol	604/8040 (3510) (3520)	0.58 0.58	87 83	5.6 8.4	11 21	2.5 7.5	3,4 3,4	
4-Chloro-3-methyl phenol	604/8040 (3510) (3520)	1.8 1.8	102 87	2.3 1.2	11 16	3.0 1.4	3,4 3,4	
2,4-Dichlorophenol	604/8040 (3510) (3520)	0.68 0.68	100 83	4.4 4.8	12 18	5.1 6.2	3,4 3,4	
2,4-Dimethylphenol	604/8040 (3510) (3520)	0.63 0.63	97 62	2.7 16	15 30	6.1 8.9	3,4 3,4	
2,4-Dinitrophenol	604/8040 (3510) (3520)	0.50 0.50	106 80	5.5 15.8	17 27	4.1 4.5	3,4 3,4	
2-Methyl-4,6-dinitrophenol	604/8040 (3510) (3520)	0.50 0.50	100 109	4.4 16.1	12 29	5.1 6.6	3,4 3,4	
2-Nitrophenol	604/8040 (3510) (3520)	0.77 0.77	98 90	2.3 15.2	10 30	6.0 7.0	3,4 3,4	

Parameter	EPA Method (Prep)	Detection Limit (ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
4-Nitrophenol	604/8040 (3510)	0.60	101	1.4	13	2.5	3,4	
	(3520)	0.60	64	1.8	17	4.3	3,4	
Pentachlorophenol	604/8040 (3510)	0.60	110	2.0	15	1.9	3,4	
	(3520)	0.60	83	3.5	22	5.8	3,4	
Phenol	604/8040 (3510)	2.2	94	8.0	10	6.0	3,4	
	(3520)	2.2	84	9.5	20	8.8	3,4	
2,4,6-Trichlorophenol	604/8040 (3510)	0.60	95	11.0	19	6.1	3,4	
	(3520)	0.60	86	10.0	13	2.4	3,4	
Bis(2-ethylhexyl)phthalate	606/8060 (3510)	20	92	4.8	24	6.0	3,4	
	(3520)	20	86	15.4	26	7.3	3,4	
Butyl benzyl phthalate	606/8060 (3510)	15	93	18.0	22	4.8	3,4	
	(3520)	15	112	5.1	20	9.4	3,4	
Diethyl phthalate	606/8060 (3510)	31	84	11.8	2	1.4	3,4	
	(3520)	31	95	2.3	2	1.4	3,4	
Dimethyl phthalate	606/8060 (3510)	19	98	4.5	15	1.8	3,4	
	(3520)	19	93	5.1	13	5.7	3,4	
Di-n-butyl phthalate	606/8060 (3510)	14	101	4.5	25	5.0	3,4	
	(3520)	14	95	3.6	15	3.2	3,4	
Di-n-octyl phthalate	606/8060 (3510)	31	110	2.0	12	7.2	3,4	
	(3520)	31	95	2.3	9	3.0	3,4	
Aldrin	608/8080 (3510)	0.05	105	7.6	8	1.5	3,4	
	(3520)	0.05	108	4.7	10	4.2	3,4	
	617 (3510)	0.05	78	5.4	6	6.0	4	
alpha-BHC	608/8080 (3510)	0.05	75	5.0	25	5.3	3,4	
	(3520)	0.05	98	24	14	1.1	3,4	
	617 (3510)	0.05	95	8.9	15	3.4	4	
beta-BHC	608/8080 (3510)	0.05	101	4.1	25	11.0	3,4	
	(3520)	0.05	78	26	20	2.9	3,4	
	617 (3510)	0.05	95	7.2	21	3.2	4	
delta-BHC	608/8080 (3510)	0.10	94	17.1	30	14.8	3,4	
	(3520)	0.10	101	23	17	7.0	3,4	
	617 (3510)	0.10	97	6.1	16	7.6	4	
gamma-BHC (Lindane)	608/8080 (3510)	0.05	101	10.1	30	7.0	3,4	
	(3520)	0.05	86	23	15	7.1	3,4	
	617 (3510)	0.05	97	7.2	15	7.8	4	
Chlordane	608/8080 (3510)	0.10	72	7.7	13	1.5	3,4	
	(3520)	0.10	109	27	15	6.2	3,4	
	617 (3510)	0.10	107	20	15	5.9	4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
4,4'-DDD	608/8080 (3510)	0.10	98	11.0	30	4.4	3,4	
	(3520)	0.10	69	13	15	4.0	3,4	
	617 (3510)	0.10	67	6.0	11	5.4	4	
4,4'-DDE	608/8080 (3510)	0.05	101	10.1	30	7.0	3,4	
	(3520)	0.05	108	26	16	3.9	3,4	
	617 (3510)	0.05	85	6.0	37	6.7	4	
4,4'-DDT	608/8080 (3510)	0.10	97	2.6	10	5.1	3,4	
	(3520)	0.10	80	13	10	4.1	3,4	
	617 (3510)	0.10	91	4.5	15	6.1	4	
Dieldrin	608/8080 (3510)	0.05	106	2.0	13	2.0	3,4	
	(3520)	0.05	115	24	11	7.2	3,4	
	617 (3510)	0.05	98	9.8	12	5.3	4	
Endosulfan I	608/8080 (3510)	0.10	114	1.1	12	2.6	3,4	
	(3520)	0.10	114	28	15	6.0	3,4	
	617 (3510)	0.10	101	7.6	17	7.8	4	
Endosulfan II	608/8080 (3510)	0.05	97	2.6	10	5.1	3,4	
	(3520)	0.05	101	17	12	8.1	3,4	
	617 (3510)	0.05	93	4.8	11	7.2	4	
Endosulfan sulfate	608/8080 (3510)	0.50	92	3.3	10	7.3	3,4	
	(3520)	0.50	114	18	10	6.4	3,4	
	617 (3510)	0.50	97	10	10	5.0	4	
Endrin	608/8080 (3510)	0.10	98	2.3	10	6.0	3,4	
	(3520)	0.10	126	10.4	15	9.0	3,4	
	617 (3510)	0.10	75	12.5	17	7.3	4	
Endrin aldehyde	608/8080 (3510)	0.20	97	2.7	15	6.1	3,4	
	(3520)	0.20	119	12.6	18	6.1	3,4	
	617 (3510)	0.20	75	13.1	13	7.2	4	
Endrin ketone	608/8080 (3510)	0.1	96	3.8	12	5.1	3,4	
	(3520)	0.1	135	14.0	20	5.6	3,4	
	617 (3510)	0.1	101	18	20	6.6	4	
Heptachlor	608/8080 (3510)	0.05	110	2.3	11	3.0	3,4	
	(3520)	0.05	86	15.4	20	7.4	3,4	
Heptachlor epoxide	608/8080 (3510)	1.0	99	1.2	10	1.9	3,4	
	(3520)	1.0	113	12.6	20	9.6	3,4	
Methoxychlor	8080 (3510)	2.0	96	3.0	13	6.1	3	
	(3520)	2.0	99	21	15	8.3	3	
	617 (3510)	2.0	92	3.3	10	7.3	4	
Toxaphene	608/8080 (3510)	2.0	97	3.1	15	4.8	3,4	
	(3520)	2.0	127	23	16	7.1	3,4	
	617 (3510)	2.0	97	2.6	15	3.9	4	

Parameter	EPA Method (Prep)	Detection Limit (ug/L)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
PCB-1016	608/8080 (3510)	0.20	103	3.8	15	5.8	3,4	
	(3520)	0.20	81	5.0	12	4.6	3,4	
	617 (3510)	0.20	104	1.7	13	2.0	4	
PCB-1221	608/8080 (3510)	0.20	100	3.4	17	1.3	3,4	
	(3520)	0.20	96	6.5	11	1.0	3,4	
	617 (3510)	0.20	98	8.3	12	1.1	4	
PCB-1232	608/8080 (3510)	0.20	97	2.8	13	5.0	3,4	
	(3520)	0.20	91	10.7	13	9.1	3,4	
	617 (3510)	0.20	99	2.3	16	5.9	4	
PCB-1242	608/8080 (3510)	0.20	98	3.1	12	3.0	3,4	
	(3520)	0.20	93	7.0	11	3.2	3,4	
	617 (3510)	0.20	101	1.8	10	7.2	4	
PCB-1248	608/8080 (3510)	0.20	101	1.4	10	7.7	3,4	
	(3520)	0.20	97	10.6	12	6.1	3,4	
	617 (3510)	0.20	98	9.0	12	2.0	4	
PCB-1254	608/8080 (3510)	0.20	104	1.4	16	4.9	3,4	
	(3520)	0.20	76	20	17	2.3	3,4	
	617 (3510)	0.20	98	8.3	12	1.1	4	
PCB-1260	608/8080 (3510)	0.20	97	2.8	13	5.0	3,4	
	(3520)	0.20	66	4.7	10	1.0	3,4	
	617 (3510)	0.20	99	2.3	16	5.9	4	
Acenaphthene	610/8100 (3510)	1	96	12.0	21	2.4	3,4	
	610/8100 (3520)	1	82	5.4	39	7.6	3,4	
	610/8310 (3520)	1	89	6.4	20	3.0		
Acenaphthylene	610/8100 (3510)	1	100	15.0	18	1.2	3,4	
	610/8100 (3520)	1	69	18.9	36	2.9	3,4	
	610/8310 (3520)	1	71	17.0	17	7.1	3,4	
Anthracene	610/8100 (3510)	1	108	10.0	10	14.0	3,4	
	610/8100 (3520)	1	110	12.6	23	8.6	3,4	
	610/8310 (3520)	1	90	9.8	15	4.5	3,4	
Benzo(a)anthracene	610/8100 (3510)	1	77	18.0	28	13.0	3,4	
	610/8100 (3520)	1	73	5.0	28	4.0	3,4	
	610/8310 (3520)	1	71	11.0	12	3.4	3,4	
Benzo(a)pyrene	610/8100 (3510)	1	96	17.0	26	11.0	3,4	
	610/8100 (3520)	1	65	10.0	38	1.0	3,4	
	610/8310 (3520)	1	69	19.0	11	5.6	3,4	
Benzo(b)fluoranthene	610/8100 (3510)	1	95	14.0	23	2.3	3,4	
	610/8100 (3520)	1	78	21.0	10	4.0	3,4	
	610/8310 (3520)	1	80	17.0	9	6.6	3,4	
Benzo(k)fluoranthene	610/8100 (3510)	1	76	20.0	36	9.4	3,4	
	610/8100 (3520)	1	60	10.0	40	10.0	3,4	
	610/8310 (3520)	1	67	11.0	12	7.1	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/L)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Benzo(g,h,i)perylene	610/8100 (3510)	1	100	13.0	20	6.0	3,4	
	610/8100 (3520)	1	64	12.0	15	5.4	3,4	
	610/8310 (3520)	1	69	10.0	13	4.3	3,4	
Chrysene	610/8100 (3510)	1	91	9.3	21	4.3	3,4	
	610/8100 (3520)	1	77	18.0	16	7.0	3,4	
	610/8310 (3520)	1	70	19.0	21	4.9	3,4	
Fluoranthene	610/8100 (3510)	1	111	11.0	22	7.8	3,4	
	610/8100 (3520)	1	75	7.0	22	6.0	3,4	
	610/8310 (3520)	1	70	4.3	15	2.8	3,4	
Fluorene	610/8100 (3510)	1	90	5.0	21	6.7	3,4	
	610/8100 (3520)	1	108	5.2	40	11.2	3,4	
	610/8310 (3520)	1	98	7.9	25	8.0	3,4	
Indeno(1,2,3-cd)pyrene	610/8100 (3510)	1	92	5.7	21	5.6	3,4	
	610/8100 (3520)	1	80	6.0	29	7.0	3,4	
	610/8310 (3520)	1	95	8.5	20	4.6	3,4	
Dibenzo(a,h)anthracene	610/8100 (3510)	1	95	10.0	17	1.7	3,4	
	610/8100 (3520)	1	67	11.0	24	2.0	3,4	
	610/8310 (3520)	1	75	5.8	25	6.6	3,4	
1-Methylnaphthalene	610/8100 (3510)	1	94	3.1	21	5.9	3,4	
	610/8100 (3520)	1	110	10.0	28	5.6	3,4	
	610/8310 (3520)	1	95	8.5	15	1.3	3,4	
2-Methylnaphthalene	610/8100 (3510)	1	86	3.0	25	4.7	3,4	
	610/8100 (3520)	1	120	13.5	30	11.1	3,4	
	610/8310 (3520)	1	100	11.2	25	9.7	3,4	
Naphthalene	610/8100 (3510)	1	96	7.8	18	9.1	3,4	
	610/8100 (3520)	1	117	7.0	28	18.0	3,4	
	610/8310 (3520)	1	98	5.5	20	10.0	3,4	
Phenanthrene	610/8100 (3510)	1	95	8.0	17	4.6	3,4	
	610/8100 (3520)	1	125	9.5	30	5.0	3,4	
	610/8310 (3520)	1	102	8.9	22	6.8	3,4	
Pyrene	610/8100 (3510)	1	95	19.0	25	5.4	3,4	
	610/8100 (3520)	1	85	12.0	25	1.4	3,4	
	610/8310 (3520)	1	98	6.8	15	5.6	3,4	
Azinphos methyl	614/8140 (3510)	0.10	90	5.0	21	6.7	3,4	
	(3520)	0.10	73	18.8	26	10.0	3,4	
Bolstar	8140 (3510)	0.10	104	10.6	15	9.4	3	*
	(3520)	0.10	65	6.3	35	14.5	3	*
Chlorpyrifos	8140 (3510)	0.10	86	3.0	25	4.7	3	*
	(3520)	0.10	98	5.5	28	9.8	3	*
Coumaphos	8140 (3510)	0.10	90	6.1	25	11.7	3	*
	(3520)	0.10	109	12.7	30	11.5	3	*
Demeton-O	614/8140 (3510)	0.10	87	18.8	15	10.7	3,4	*
	(3520)	0.10	67	10.5	18	5.8	3,4	*

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Demeton-S	614/8140 (3510)	0.10	103	5.1	12	3.2	3,4	*
	(3520)	0.10	100	11.5	35	6.8	3,4	*
Diazinon	614/8140 (3510)	0.10	98	6.8	10	3.7	3,4	*
	(3520)	0.10	67	6.0	11	5.4	3,4	*
Dichlorvos	8140 (3510)	0.10	98	10.0	16	1.1	3	*
	(3520)	0.10	72	7.7	13	1.5	3	*
Disulfoton	614/8140 (3510)	0.10	104	2.4	16	3.9	3,4	*
	(3520)	0.10	82	9.0	20	8.9	3,4	*
Ethion	614 (3510)	0.10	89	6.0	12	7.0	4	*
	(3520)	0.10	97	5.0	10	5.4	4	*
Ethoprop	8140 (3510)	0.10	100	3.4	10	5.6	3	*
	(3520)	0.10	101	4.1	25	11.0	3	*
Fensulfothion	8140 (3510)	0.10	112	12.2	15	10.1	3	*
	(3520)	0.10	94	17.1	30	14.8	3	*
Fenthion	8140 (3510)	0.10	113	5.4	15	4.2	3	*
	(3520)	0.10	69	19.9	22	5.9	3	*
Malathion	614 (3510)	0.10	97	2.3	12	1.9	4	*
	(3520)	0.10	98	10.0	16	1.1	4	*
Merphos	8140 (3510)	0.05	97	3.6	15	4.3	3	*
	(3520)	0.05	121	7.9	35	16.5	3	*
Mevinphos	8140 (3510)	0.01	94	1.5	15	4.4	3	*
	(3520)	0.01	57	7.8	15	1.9	3	*
Parathion, ethyl	614 (3510)	0.10	93	6.0	14	5.4	4	*
	(3520)	0.10	77	6.5	15	4.2	4	*
Naled	8140 (3510)	0.10	86	3.0	13	5.6	3	*
	(3520)	0.10	78	8.1	20	5.6	3	*
Parathion, methyl	614/8140 (3510)	0.05	99	4.7	15	3.9	3,4	*
	(3520)	0.05	96	5.3	25	8.8	3,4	*
Phorate	8140 (3510)	0.01	100	5.3	14	5.7	3	*
	(3520)	0.01	63	8.9	13	1.5	3	*
Ronnel	8140 (3510)	0.01	97	4.4	12	5.8	3	*
	(3520)	0.01	99	5.6	18	5.2	3	*
Stirophos (Tetrachlorovinphos)	8140 (3510)	0.05	115	12.1	12	4.0	3	*
	(3520)	0.05	66	5.9	11	1.1	3	*
Tokuthion (Prothiofos)	8140 (3510)	0.05	89	15.0	23	7.0	3	*
	(3520)	0.05	65	6.8	16	1.4	3	*
Trichloronate	8140 (3510)	0.50	81	13.0	19	3.7	3	*
	(3520)	0.50	105	18.6	26	5.9	3	*

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
2,4-D	615/8150	0.5	75	4.0	12	1.6	3,4	
2,4-DB	615/8150	0.5	93	3.0	18	4.6	3,4	
2,4,5-T	615/8150	0.3	85	6.0	25	12.5	3,4	
2,4,5-TP (Silvex)	615/8150	0.1	88	5.0	20	9.8	3,4	
Dalapon	8150	10	66	8.0	36	15.2	3	
Dicamba	8150	0.1	79	7.0	32	9.8	3	
Dichloroprop	8150	0.5	97	2.0	27	11.2	3	
Dinoseb	8150	0.5	86	4.0	30	10.0	3	
MCPA	8150	10	98	4.0	25	5.8	3	
MCPP	8150	10	94	4.0	21	6.8	3	
Captan	617	1.0	64	12.0	15	5.4	4	*
Carbophenothion	617	1.0	98	7.9	25	8.0	4	*
Dichloran	617	1.0	67	11.0	24	2.0	4	*
Dicofol	617	0.1	95	8.5	15	1.3	4	*
Isodrin	617	1.0	102	8.9	22	6.8	4	*
Mirex	617	0.2	125	9.5	30	5.0	4	*
PCNB	617	0.01	70	4.3	15	2.8	4	*
Perthane	617	5.0	100	11.2	25	9.7	4	*
Strobane	617	2.0	73	18.8	26	10.0	4	*
Trifluralin	617	1.0	70	19.0	21	4.9	4	*
Chloropicrin	617	0.5	80	6.0	20	4.6	4	*

Parameter	EPA Method	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Ametryn	619	0.1	135	4.1	25	1.9	4	*
Atraton	619	5.0	126	9.3	25	1.9	4	*
Atrazine	619	0.1	130	6.5	16	7.9	4	*
Prometryn	619	0.1	86	7.2	21	10.3	4	*
Propazine	619	0.1	95	11.3	18	11.1	4	*
Secbumeton	619	5.0	87	15.0	30	9.4	4	*
Simetryn	619	0.1	76	20.0	22	8.3	4	*
Simazine	619	0.1	90	37.0	20	10.1	4	*
Terbutylazine	619	0.1	91	9.3	20	9.7	4	*
Terbutryn	619	0.1	99	40.0	20	10.0	4	*
Prometon	619	0.1	89	13.7	18	2.1	4	*
Azinphos methyl	622	2.0	75	10.3	20	12.0	4	*
Bolstar	622	0.2	122	12.2	15	7.3	4	*
Chloropyrifos	622	0.5	85	14.2	25	12.5	4	*
Chloropyrifos methyl	622	0.5	89	15.0	23	7.0	4	*
Coumaphos	622	2.0	90	9.8	27	6.0	4	*
Demeton	622	0.5	85	7.4	27	5.9	4	*
Diazinon	622	1.0	82	9.0	20	8.9	4	*
Dichlorvos	622	0.2	100	11.5	35	6.8	4	*
Disulfoton	622	0.5	91	7.6	15	4.5	4	*
Ethoprop	622	0.5	100	3.4	13	5.1	4	*
Fensulfothion	622	2.0	93	6.3	14	6.0	4	*
Fenthion	622	0.2	112	4.9	15	5.4	4	*
Merphos	622	0.5	77	6.5	15	4.2	4	*
Mevinphos	622	0.5	98	6.1	14	6.4	4	*

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Acetone	8240 (5030)	10	135	9.9	25	10.1	3	
Acetonitrile	8240 (5030)	10	116	8.1	27	14.1	3	
Acrolein	8240 (5030)	100	140	10.6	25	7.3	3	
Acrylonitrile	8240 (5030)	100	145	11.3	25	9.9	3	
Allyl Chloride	8240 (5030)	100	106	10.2	15	10.4	3	
Benzene	624/8240 (5030)	1	95	2.0	30	17.4	3,4	
Bromodichloromethane	624/8240 (5030)	1	103	15.8	15	5.9	3,4	
Bromoform	624/8240 (5030)	2	118	23.5	15	3.4	3,4	
Bromomethane	624/8240 (5030)	1	100	10.0	27	13.0	3,4	
2-Butanone (MEK)	8240 (5030)	3	131	20.0	30	14.0	3	
Carbon disulfide	8240 (5030)	1	119	18.2	27	15.1	3	
Carbon tetrachloride	624/8240 (5030)	2	110	16.8	12	2.5	3,4	
Chloroethane	624/8240 (5030)	1	121	16.9	17	6.1	3,4	
Chlorobenzene	624/8240 (5030)	1	98	22.8	16	9.0	3,4	
2-Chloroethyl vinyl ether	624/8240 (5030)	5	100	10.0	20	6.2	3,4	
Chloroform	624/8240 (5030)	2	93	3.3	16	2.2	3,4	
Chloromethane	624/8240 (5030)	2	113	18.1	27	21.4	3,4	
Chloropropene	8240 (5030)	2	95	2.0	15	9.1	3	
Chlorodibromoethane	624/8240 (5030)	5	101	3.0	17	1.8	3,4	
Dibromomethane	8240 (5030)	5	110	4.6	20	9.2	3	
1,4-Dichloro-2-butane	8240 (5030)	5	131	5.1	20	8.7	3	
Dichlorodifluoromethane	8240 (5030)	5	127	10.2	25	7.6	3	
1,2-Dichlorobenzene	624/8240 (5030)	2	94	4.5	22	14.5	3,4	
1,3-Dichlorobenzene	624/8240 (5030)	2	110	16.8	14	4.8	3,4	
1,4-Dichlorobenzene	624/8240 (5030)	2	95	4.5	22	14.5	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,1-Dichloroethane	624/8240 (5030)	1	105	3.6	13	5.0	3,4	
1,2-Dichloroethane	624/8240 (5030)	2	102	4.5	17	3.2	3,4	
1,2-Dichloroethene (total)	8240 (5030)	5	130	10.0	25	7.2	3	
1,1-Dichloroethene	624/8240 (5030)	1	112	6.1	17	10.6	3,4	
1,2-Dichloropropane	624/8240 (5030)	2	100	10.0	25	3.0	3,4	
cis-1,3-Dichloropropene	624/8240 (5030)	1	100	10.0	23	8.0	3,4	
trans-1,3-Dichloropropene	624/8240 (5030)	1	100	10.0	25	5.0	3,4	
Ethanol	8240 (5030)	50	110	9.9	20	7.8	3	
Ethylbenzene	624/8240 (5030)	1	98	24.8	14	10.0	3,4	
Ethyl methacrylate	8240 (5030)	5	111	3.9	20	7.9	3	
Methyl methacrylate	8240 (5030)	5	76	6.1	21	5.2	3	
Pentachloroethane	8240 (5030)	5	100	11.5	35	6.8	3	
Propionitrile	8240 (5030)	5	109	9.0	25	8.1	3	
Pyridine	8240 (5030)	5	80	15.8	27	4.5	3	
2-Hexanone	8240 (5030)	3	140	8.7	21	8.1	3	
Iodomethane	8240 (5030)	5	136	7.4	25	5.7	3	
Isobutyl alcohol	8240 (5030)	5	113	5.1	21	5.6	3	
Methyl Bromide	8240 (5030)	3	106	2.0	13	2.0	3	
Methyl Chloride	8240 (5030)	3	108	3.1	10	2.5	3	
Methylene Bromide	8240 (5030)	3	106	5.5	17	4.1	3	
Methylene chloride	624/8240 (5030)	3	87	18.8	15	10.7	3,4	
Methyl Iodine	8240 (5030)	3	92	3.3	10	7.3	3	
1,4-Dioxane	8240 (5030)	3	98	8.8	18	11.7	3	
4-Methyl-2-pentanone	8240 (5030)	3	90	6.1	20	11.7	3	
Styrene	8240 (5030)	2	95	12.2	27	10.8	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,1,1,2-Tetrachloroethane	8240 (5030)	2	109	13.0	20	7.0	3	
1,1,2,2-Tetrachloroethane	624/8240 (5030)	2	93	17.6	16	6.9	3,4	
Tetrachloroethene	624/8240 (5030)	1	106	6.0	13	1.8	3,4	
Toluene	624/8240 (5030)	1	98	2.3	15	7.1	3,4	
Trans-1,4-Dichloro-2-Butene	8240 (5030)	1	97	3.7	11	3.0	3	
1,1,1-Trichloroethane	624/8240 (5030)	5	106	7.3	12	1.5	3,4	
1,1,2-Trichloroethane	624/8240 (5030)	2	95	17.1	14	2.0	3,4	
Trichloroethene	624/8240 (5030)	1	104	22.7	13	3.6	3,4	
Trichlorofluoromethane	624/8240 (5030)	1	99	3.9	28	15.0	3,4	
1,2,3-Trichloropropane	8240 (5030)	5	131	4.7	27	15.1	3	
Vinyl acetate	8240 (5030)	2	129	5.0	25	16.2	3	
Vinyl chloride	624/8240 (5030)	1	100	10.0	30	18.0	3,4	
Xylenes	624/8240 (5030)	4	115	11.0	12	9.0	3,4	
Acenaphthene	625/8270 (3510)	10	110	9.2	12	1.7	3,4	
	(3520)	10	96	19.0	15	12.0	3,4	
Acenaphthylene	625/8270 (3510)	10	100	4.0	10	4.1	3,4	
	(3520)	10	89	7.4	25	10.6	3,4	
Acetophenone	8270 (3510)	10	105	10.1	20	7.6	3	
	(3520)	10	90	13.0	20	11.0	3	
2-Acetylaminofluorene	8270 (3510)	10	95	5.9	19	5.1	3	
	(3520)	10	75	14.4	21	12.9	3	
Aldrin	625/8270 (3510)	10	99	6.7	13	6.6	3,4	
	(3520)	10	78	16.6	27	12.8	3,4	
4-Aminobiphenyl	8270 (3510)	10	103	16.6	18	7.3	3	
	(3520)	10	70	17.1	30	13.8	3	
Aniline	8270 (3510)	10	109	4.9	19	5.1	3	
	(3520)	10	70	7.6	21	14.0	3	
Anthracene	625/8270 (3510)	10	81	5.1	11	2.2	3,4	
	(3520)	10	80	6.8	20	13.2	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/L)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Aramite	8270 (3510)	10	97	2.8	13	5.0	3	
	(3520)	10	73	8.1	22	15.0	3	
Benzidine	625/8270 (3510)	80	103	2.0	14	1.1	3,4	
	(3520)	80	75	10.2	25	17.0	3,4	
Benzo(a)anthracene	625/8270 (3510)	80	98	3.2	12	2.3	3,4	
	(3520)	80	75	10.2	28	17.0	3,4	
Benzo(b)fluoranthene	625/8270 (3510)	80	99	1.0	12	3.0	3,4	
	(3520)	80	75	10.2	25	17.0	3,4	
Benzo(k)fluorathene	625/8270 (3510)	80	104	3.4	16	5.4	3,4	
	(3520)	80	75	10.2	28	17.0	3,4	
Benzo(ghi)perylene	625/8270 (3510)	80	98	8.3	12	1.1	3,4	
	(3520)	80	75	10.2	26	17.0	3,4	
Benzo(a)pyrene	625/8270 (3510)	80	98	8.3	15	6.4	3,4	
	(3520)	80	75	10.2	32	17.0	3,4	
Benzyl alcohol	625/8270 (3510)	80	100	2.4	12	3.4	3,4	
	(3520)	80	75	10.2	27	17.0	3,4	
Bis(2-Chloro-1-methyl-ethyl ether	625/8270 (3510)	80	89	5.9	10	1.1	3,4	
	(3520)	80	75	10.2	14	17.0	3,4	
delta-BHC	625/8270 (3510)	10	103	3.8	15	5.8	3,4	
	(3520)	10	91	10.3	37	18.1	3,4	
gamma-BHC	625/8270 (3510)	10	89	12.1	12	2.1	3,4	
	(3520)	10	91	11.0	25	18.2	3,4	
Bis(2-chloroethoxy)methane	625/8270 (3510)	10	85	15.0	20	2.9	3,4	
	(3520)	10	112	15.4	16	13.4	3,4	
Bis(2-chloroethyl)ether	625/8270 (3510)	10	80	11.3	23	13.7	3,4	
	(3520)	10	86	15.4	30	9.9	3,4	
Bis(2-chloroisopropyl)ether	625/8270 (3510)	10	93	5.2	28	6.0	3,4	
	(3520)	10	103	23.1	24	2.8	3,4	
Bis(2-ethylhexyl)phthalate	625/8270 (3510)	10	73	8.3	21	5.1	3,4	
	(3520)	10	89	11.8	26	7.3	3,4	
4-Bromophenyl phenyl ether	625/8270 (3510)	10	96	3.6	20	7.6	3,4	
	(3520)	10	91	13.4	13	6.6	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Butyl benzyl phthalate	625/8270 (3510)	10	81	5.0	12	4.6	3,4	
	(3520)	10	95	2.0	15	7.1	3,4	
Chlordane	625/8270 (3510)	10	91	10.7	13	9.1	3,4	
	(3520)	10	90	2.1	16	8.9	3,4	
p-Chloroaniline	8270 (3510)	20	120	15.0	20	6.1	3	
	(3520)	20	85	2.5	20	9.0	3	
Chlorobenzilate	8270 (3510)	10	93	5.2	22	5.3	3	
	(3520)	10	86	2.5	19	10.0	3	
4-Chloro-3-methylphenol (p-chloro-m-cresol)	625/8270 (3510)	10	93	6.5	15	4.6	3,4	
	(3520)	10	84	3.5	23	7.5	3,4	
1-Chloronaphthalene	8270 (3510)	10	92	5.7	21	5.6	3	
	(3520)	10	85	3.1	20	7.6	3	
2-Chloronaphthalene	625/8270 (3510)	10	91	6.0	21	6.1	3,4	
	(3520)	10	89	2.9	21	8.7	3,4	
2-Chlorophenol	625/8270 (3510)	20	86	3.0	25	4.7	3,4	
	(3520)	20	90	2.9	23	9.0	3,4	
4-Chlorophenylphenyl ether	625/8270 (3510)	10	104	7.0	17	9.0	3,4	
	(3520)	10	91	5.3	20	9.4	3,4	
Chrysene	625/8270 (3510)	10	95	19.0	21	4.6	3,4	
	(3520)	10	93	10.0	28	13.0	3,4	
2-Methylphenol(o-cresol)	8270 (3510)	10	114	4.6	20	4.5	3	
	(3520)	10	94	10.1	25	1.3	3	
4-Methylphenol(p-cresol)	8270 (3510)	10	112	11.0	21	9.3	3	
	(3520)	10	95	11.1	26	9.1	3	
3-Methylphenol (m-cresol)	8270 (3510)	10	98	15.0	20	3.9	3	
	(3520)	10	79	8.0	21	4.1	3	
4,4'-DDD	625/8270 (3510)	10	99	15.0	14	6.3	3,4	
	(3520)	10	56	4.0	20	3.2	3,4	
4,4'-DDE	625/8270 (3510)	10	94	17.0	26	11.0	3,4	
	(3520)	10	70	5.4	26	11.7	3,4	
4,4'-DDT	625/8270 (3510)	10	77	12.0	13	6.7	3,4	
	(3520)	10	79	3.3	35	19.0	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Diallate	625/8270 (3510)	10	91	11.6	15	5.0	3,4	
	(3520)	10	64	6.0	20	9.0	3,4	
Dibenzo(a,h)anthracene	625/8270 (3510)	10	112	12.2	15	10.1	3,4	
	(3520)	10	88	4.7	18	8.5	3,4	
Dibenzofuran	625/8270 (3510)	10	98	10.0	16	1.1	3,4	
	(3520)	10	73	5.0	20	2.0	3,4	
Di-n-butyl phthalate	625/8270 (3510)	10	99	15.9	11	8.3	3,4	
	(3520)	10	60	7.1	13	11.6	3,4	
1,2-Dichlorobenzene	625/8270 (3510)	10	89	6.0	12	7.0	3,4	
	(3520)	10	80	2.8	20	4.7	3,4	
1,3-Dichlorobenzene	625/8270 (3510)	10	100	1.8	15	9.4	3,4	
	(3520)	10	86	7.0	25	6.8	3,4	
1,4-Dichlorobenzene	625/8270 (3510)	10	91	11.6	15	2.8	3,4	
	(3520)	10	73	14.7	24	2.3	3,4	
3,3'-Dichlorobenzidine	625/8270 (3510)	10	99	1.6	15	5.3	3,4	
	(3520)	10	120	12.6	28	7.3	3,4	
2,4-Dichlorophenol	625/8270 (3510)	10	107	2.7	13	6.6	3,4	
	(3520)	10	87	1.3	15	1.3	3,4	
2,6-Dichlorophenol	8270 (3510)	10	93	2.3	12	1.9	3	
	(3520)	10	75	5.0	15	3.4	3	
Dieldrin	625/8270 (3510)	10	100	3.3	12	6.1	3,4	
	(3520)	10	82	1.6	20	1.6	3,4	
Diethyl phthalate	625/8270 (3510)	10	96	4.3	10	5.4	3,4	
	(3520)	10	100	10.4	19	14.4	3,4	
Dimethoate	8270 (3510)	10	100	3.4	10	6.0	3	
	(3520)	10	90	3.4	20	5.4	3	
p-(Dimethylamino)azobenzene	8270 (3510)	10	96	2.4	15	5.6	3	
	(3520)	10	80	5.6	21	5.0	3	
7,12-Dimethylbenz(a)anthracene	8270 (3510)	10	98	6.8	10	3.7	3	
	(3520)	10	73	1.1	25	6.2	3	
3,3'-Dimethylbenzidine	8270 (3510)	10	98	2.4	15	2.6	3	
	(3520)	10	64	3.9	20	6.7	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
alpha,alpha-Dimethyl phenethylamine	8270 (3510)	10	97	2.7	15	6.1	3	
	(3520)	10	74	4.0	24	6.1	3	
2,4-Dimethylphenol	625/8270 (3510)	10	99	1.7	10	5.4	3,4	
	(3520)	10	75	5.3	21	9.0	3,4	
4,6-Dinitro-O-Cresol	8270 (3510)	10	106	5.5	17	4.1	3	
	(3520)	10	86	2.6	21	6.2	3	
Dimethyl phthalate	625/8270 (3510)	10	100	4.4	12	5.1	3,4	
	(3520)	10	75	5.0	22	8.7	3,4	
m-Dinitrobenzene	8270 (3510)	10	98	2.5	12	5.6	3	
	(3520)	10	75	7.0	26	10.1	3	
4,6-Dinitro-2-methylphenol	625/8270 (3510)	50	96	3.8	12	5.1	3,4	
	(3520)	50	76	3.9	30	11.3	3,4	
2,4-Dinitrophenol	625/8270 (3510)	50	106	5.5	17	4.1	3,4	
	(3520)	50	79	9.9	29	10.2	3,4	
2,4-Dinitrotoluene	625/8270 (3510)	10	114	1.1	12	2.6	3,4	
	(3520)	10	101	10.1	25	10.0	3,4	
2,6-Dinitrotoluene	625/8270 (3510)	10	99	1.2	10	1.9	3,4	
	(3520)	10	112	11.1	26	11.0	3,4	
Dinoseb	8270 (3510)	50	97	3.7	11	3.0	3	
	(3520)	50	90	11.0	27	12.3	3	
Di-n-octyl phthalate	625/8270 (3510)	10	97	2.7	15	6.1	3,4	
	(3520)	10	91	12.0	15	15.1	3,4	
Diphenylamine (N-Nitroso- diphenylamine)	625/8270 (3510)	10	104	1.7	13	2.0	3,4	
	(3520)	10	92	13.0	25	19.0	3,4	
1,2-Diphenylhydrazine	8270 (3510)	10	103	3.8	15	5.8	3	
	(3520)	10	90	14.1	25	17.3	3	
Disulfoton	8270 (3510)	10	98	9.0	12	2.0	3	
	(3520)	10	97	6.1	15	2.9	3	
Endosulfan I	625/8270 (3510)	10	99	2.3	16	5.9	3,4	
	(3520)	10	60	5.2	13	9.1	3,4	
Endosulfan II	625/8270 (3510)	10	98	2.4	12	6.0	3,4	
	(3520)	10	65	6.2	30	8.4	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/L)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Endosulfan sulfate	625/8270 (3510)	10	99	6.7	13	6.6	3,4	
	(3520)	10	73	7.0	25	7.6	3,4	
Endrin	625/8270 (3510)	10	100	4.8	11	5.6	3,4	
	(3520)	10	75	8.3	20	3.9	3,4	
Endrin aldehyde	625/8270 (3510)	10	100	4.9	21	7.0	3,4	
	(3520)	10	76	9.8	22	4.0	3,4	
Endrin ketone	8270 (3510)	10	81	1.3	20	6.0	3	
	(3520)	10	77	9.3	26	5.7	3	
Ethyl methacrylate	8270 (3510)	10	95	5.9	19	5.1	3	
	(3520)	10	80	5.5	23	7.7	3	
Ethyl methane sulfonate	8270 (3510)	10	109	6.7	17	4.7	3	
	(3520)	10	85	7.4	24	8.9	3	
Ethyl parathion	8270 (3510)	10	97	5.2	16	4.2	3	
	(3520)	10	75	7.9	20	6.1	3	
Famphur	8270 (3510)	10	107	10.3	13	3.5	3	
	(3520)	10	76	9.0	25	5.0	3	
Fluoranthene	625/8270 (3510)	10	110	9.2	12	1.7	3,4	
	(3520)	10	77	10.1	25	5.0	3,4	
Fluorene	625/8270 (3510)	10	109	6.0	11	1.0	3,4	
	(3520)	10	91	11.1	19	3.9	3,4	
Heptachlor	625/8270 (3510)	10	104	13.1	10	6.2	3,4	
	(3520)	10	87	3.9	30	4.7	3,4	
Heptachlor epoxide	625/8270 (3510)	10	107	12.0	20	6.7	3,4	
	(3520)	10	85	5.4	23	6.1	3,4	
Hexachlorobenzene	625/8270 (3510)	10	105	10.1	20	7.6	3,4	
	(3520)	10	87	6.9	18	7.8	3,4	
Hexachlorobutadiene	625/8270 (3510)	10	103	16.6	18	7.3	3,4	
	(3520)	10	96	6.3	20	6.7	3,4	
Hexachlorocyclopentadiene	8270 (3510)	10	100	3.8	16	1.6	3	
	(3520)	10	89	2.9	28	5.4	3	
Hexachloroethane	625/8270 (3510)	10	98	6.1	15	3.9	3,4	
	(3520)	10	78	5.0	18	1.7	3,4	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Hexachloropropene	8270 (3510)	10	91	11.6	15	5.0	3	
	(3520)	10	80	5.2	26	1.4	3	
Indeno(1,2,3-cd)pyrene	625/8270 (3510)	10	88	9.8	15	2.8	3,4	
	(3520)	10	88	6.5	26	5.8	3,4	
Isodrin	8270 (3510)	10	102	6.1	15	2.6	3	
	(3520)	10	99	4.7	15	2.5	3	
Isophorone	625/8270 (3510)	10	100	1.8	15	9.4	3,4	
	(3520)	10	93	5.2	28	6.0	3,4	
Isosafrole	8270 (3510)	10	112	12.2	15	10.1	3	
	(3520)	10	66	10.5	26	3.6	3	
Kepone	8270 (3510)	10	100	3.4	10	5.6	3	
	(3520)	10	87	2.6	17	9.2	3	
Methapyrilene	8270 (3510)	10	96	4.0	10	5.7	3	
	(3520)	10	70	3.6	28	1.5	3	
Methoxychlor	8270 (3510)	10	97	5.0	10	5.4	3	
	(3520)	10	79	3.0	26	6.2	3	
3-Methylchloanthrene	8270 (3510)	10	114	16.6	11	5.7	3	
	(3520)	10	80	10.1	17	6.0	3	
Methyl methanesulfonate	8270 (3510)	10	89	6.0	12	7.0	3	
	(3520)	10	86	9.0	19	6.1	3	
2-Methylnaphthalene	8270 (3510)	10	107	2.7	13	6.6	3	
	(3520)	10	73	7.3	17	6.4	3	
1-Methylnaphthalene	8270 (3510)	10	100	3.3	12	6.1	3	
	(3520)	10	76	6.1	21	5.2	3	
Methyl parathion	8270 (3510)	10	99	15.9	11	8.3	3	
	(3520)	10	81	9.9	28	4.9	3	
Naphthalene	625/8270 (3510)	10	104	2.4	16	3.9	3,4	
	(3520)	10	135	4.1	25	1.9	3,4	
1,4-Napthoquinone	8270 (3510)	10	99	1.6	15	5.3	3	
	(3520)	10	130	6.9	23	10.2	3	
1-Napthylamine	8270 (3510)	10	98	2.4	15	5.6	3	
	(3520)	10	153	9.1	20	3.4	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/L)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
2-Naphthylamine	8270 (3510)	10	98	2.4	15	5.6	3	
	(3520)	10	126	9.3	25	1.9	3	
o-Nitroaniline	8270 (3510)	10	96	11.0	15	5.4	3	
	(3520)	10	160	9.4	26	6.4	3	
m-Nitroaniline	8270 (3510)	50	96	7.0	15	7.6	3	
	(3520)	50	110	2.2	30	5.6	3	
p-Nitroaniline	8270 (3510)	50	98	10.0	16	1.1	3	
	(3520)	50	149	12.0	16	7.2	3	
Nitrobenzene	625/8270 (3510)	10	97	5.6	13	2.6	3,4	
	(3520)	10	125	10.1	20	7.4	3,4	
2-Nitrophenol	625/8270 (3510)	10	97	2.3	12	1.9	3,4	
	(3520)	10	112	8.7	20	7.7	3,4	
4-Nitrophenol	625/8270 (3510)	50	93	11.7	12	3.0	3,4	
	(3520)	50	130	6.5	16	7.9	3,4	
4-Nitroquinoline-1-oxide	8270 (3510)	10	98	6.8	10	3.7	3	
	(3520)	10	118	4.2	25	8.1	3	
N-Nitroso-di-n-butylamine	8270 (3510)	10	101	4.0	11	4.1	3	
	(3520)	10	112	5.0	24	2.9	3	
N-Nitroso-diethylamine	8270 (3510)	10	113	5.4	15	4.2	3	
	(3520)	10	90	5.1	26	9.0	3	
N-Nitroso-di-methylamine	625/8270 (3510)	10	113	5.4	15	4.2	3,4	
	(3520)	10	91	6.1	16	10.1	3,4	
N-Nitroso-di-phenylamine	625/8270 (3510)	10	90	6.1	12	3.6	3,4	
	(3520)	10	86	7.2	21	10.3	3,4	
N-Nitroso-di-n-propylamine	625/8270 (3510)	10	90	6.1	12	3.6	3,4	
	(3520)	10	81	7.3	22	7.5	3,4	
N-Nitrosomethylethylamine	8270 (3510)	10	103	5.1	12	3.2	3	
	(3520)	10	140	9.0	30	4.5	3	
N-Nitrosomorpholine	8270 (3510)	10	129	5.0	25	16.2	3	
	(3520)	10	117	3.4	30	3.5	3	
N-Nitrosopiperidine	8270 (3510)	10	99	3.9	28	15.0	3	
	(3520)	10	106	12.1	22	4.4	3	
N-Nitrosopyrrolidine	8270 (3510)	10	93	17.6	16	6.9	3	
	(3520)	10	91	9.3	20	9.7	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
5-Nitro-o-toluidine	8270 (3510)	10	98	8.7	29	4.0	3	
	(3520)	10	95	10.1	19	10.3	3	
PCB-1016	625/8270 (3510)	100	95	10.8	14	9.4	3,4	
	(3520)	100	95	11.3	18	11.1	3,4	
PCB-1221	625/8270 (3510)	100	93	19.0	20	2.4	3,4	
	(3520)	100	94	12.9	37	9.7	3,4	
PCB-1232	625/8270 (3510)	100	95	14.0	23	2.3	3,4	
	(3520)	100	90	13.4	40	10.1	3,4	
PCB-1242	625/8270 (3510)	100	93	17.0	13	6.0	3,4	
	(3520)	100	87	15.0	30	9.4	3,4	
PCB-1248	625/8270 (3510)	100	96	7.0	26	11.0	3,4	
	(3520)	100	89	17.0	25	3.5	3,4	
PCB-1254	625/8270 (3510)	100	99	13.0	25	6.0	3,4	
	(3520)	100	93	18.0	24	4.9	3,4	
PCB-1260	625/8270 (3510)	100	101	5.0	16	4.8	3,4	
	(3520)	100	89	19.0	22	7.1	3,4	
Pentachlorobenzene	8270 (3510)	10	93	6.5	15	4.6	3	
	(3520)	10	76	20.0	22	8.3	3	
Pentachloroethane	8270 (3510)	10	94	3.1	21	5.9	3	
	(3520)	10	87	21.0	23	9.0	3	
Pentachloronitrobenzene	8270 (3510)	10	96	4.0	19	4.1	3	
	(3520)	10	90	37.0	20	10.0	3	
Pentachlorophenol	625/8270 (3510)	50	96	5.2	22	5.3	3,4	
	(3520)	50	99	40.0	20	10.0	3,4	
Phenacetin	8270 (3510)	100	93	5.2	22	5.3	3	
	(3520)	100	122	12.2	15	7.3	3	
Phenanthrene	625/8270 (3510)	10	95	10.0	17	1.7	3,4	
	(3520)	10	115	12.1	12	4.0	3,4	
Phenol	625/8270 (3510)	10	92	5.7	21	5.6	3,4	
	(3520)	10	113	11.3	19	3.7	3,4	
p-Phenylenediamine	8270 (3510)	10	92	5.7	21	5.6	3	
	(3520)	10	89	13.7	18	2.1	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Phorate	8270 (3510)	10	90	15.2	30	7.0	3	
	(3520)	10	85	12.0	20	14.0	3	
2-Picoline	8270 (3510)	10	109	16.1	29	6.6	3	
	(3520)	10	73	11.5	20	13.7	3	
Pronamide	8270 (3510)	10	80	15.8	27	4.5	3	
	(3520)	10	75	10.3	20	12.0	3	
Pyrene	625/8270 (3510)	10	62	16.0	30	8.9	3,4	
	(3520)	10	89	15.0	23	7.0	3,4	
Pyridine	8270 (3510)	10	83	4.8	18	6.2	3	
	(3520)	10	85	15.0	19	6.3	3	
Safrole	8270 (3510)	10	87	1.2	16	1.4	3	
	(3520)	10	80	12.5	23	7.3	3	
Sulfotepp	8270 (3510)	10	83	8.4	21	7.5	3	
	(3520)	10	81	13.0	27	8.4	3	
1,2,4,5-Tetrachlorobenzene	8270 (3510)	10	67	11.0	12	7.1	3	
	(3520)	10	80	11.3	27	7.3	3	
2,3,4,6-Tetrachlorophenol	8270 (3510)	10	80	17.0	9	6.6	3	
	(3520)	10	85	14.2	25	12.5	3	
o-Toluidine	8270 (3510)	10	69	19.0	11	5.6	3	
	(3520)	10	85	13.7	25	13.0	3	
Thionazin	8270 (3510)	10	71	11.0	12	3.4	3	
	(3520)	10	85	14.4	26	17.0	3	
Toxaphene	625/8270 (3510)	200	66	4.7	10	1.0	3,4	
	(3520)	200	101	10.1	30	7.0	3,4	
1,2,4-Trichlorobenzene	625/8270 (3510)	10	97	10.6	12	6.1	3,4	
	(3520)	10	90	9.8	27	6.0	3,4	
2,4,5-Trichlorophenol	8270 (3510)	10	93	7.0	11	3.2	3	
	(3520)	10	89	7.3	22	6.3	3	
2,4,6-Trichlorophenol	625/8270 (3510)	10	91	10.7	13	9.1	3,4	
	(3520)	10	85	7.4	27	5.9	3,4	
1,3,5-Trinitrobenzene	8270 (3510)	10	96	6.5	11	1.0	3	
	(3520)	10	85	6.0	37	6.7	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/l)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
O,O,O-Triethylphosphorothiate	8270 (3510)	10	67	10.5	18	5.8	3	
	(3520)	10	85	6.0	20	6.7	3	
SYM-Trinitrobenzene	8270 (3510)	10	95	8.5	20	4.6	3	
	(3520)	10	85	6.0	35	6.7	3	
Petroleum Fingerprint	Modified 8015	10	75	5.0	25	5.3	3	
2-Chloronaphthalene	612/8120 (3510)	1.0	95	8.5	20	4.6	3,4	
	(3520)	1.0	100	11.5	35	6.8	3,4	
1,2-Dichlorobenzene	612/8120 (3510)	1.0	80	6.0	29	7.0	3,4	
	(3520)	1.0	67	6.0	11	5.4	3,4	
1,3-Dichlorobenzene	612/8120 (3510)	1.0	108	5.2	40	11.2	3,4	
	(3520)	1.0	72	7.7	13	1.5	3,4	
1,4-Dichlorobenzene	612/8120 (3510)	1.0	98	7.9	25	8.0	3,4	
	(3520)	1.0	82	9.0	20	8.9	3,4	
Hexachlorobenzene	612/8120 (3510)	1.0	100	11.2	25	9.7	3,4	
	(3520)	1.0	98	5.5	20	10.0	3,4	
Hexachlorobutadiene	612/8120 (3510)	1.0	75	7.0	22	6.0	3,4	
	(3520)	1.0	101	4.1	25	11.0	3,4	
Hexachlorocyclopentadiene	612/8120 (3510)	1.0	70	4.3	15	2.8	3,4	
	(3520)	1.0	94	17.1	30	14.8	3,4	
Hexachloroethane	612/8120 (3510)	1.0	77	18.0	16	7.0	3,4	
	(3520)	1.0	69	19.9	22	5.9	3,4	
1,2,4-Trichlorobenzene	612/8120 (3510)	1.0	64	10.0	13	4.3	3,4	
	(3520)	1.0	98	11.0	30	4.4	3,4	

ORGANIC PARAMETER METHODS
 ACCURACY, PRECISION, DETECTION LIMITS AND COMPLETENESS DATA
 FOR SOIL, SLUDGE AND OTHER SEDIMENTS

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Benzyl chloride	8010 (5030)	5	97	3.6	15	4.3	3	
Bis(2-chloroethoxy)methane	8010 (5030)	5	89	7.0	14	4.7	3	
Bis(2-chloroisopropyl)ether	8010 (5030)	5	87	4.8	11	7.6	3	
Bromobenzene	8010 (5030)	5	86	3.0	13	5.6	3	
Bromodichloromethane	8010 (5030)	5	90	1.7	14	5.0	3	
Bromoform	8010 (5030)	5	94	1.5	15	4.4	3	
Bromomethane	8010 (5030)	5	95	5.0	12	8.3	3	
Carbon tetrachloride	8010 (5030)	5	91	7.6	15	4.5	3	
Chloroacetaldehyde	8010 (5030)	25	100	6.3	12	3.2	3	
Chlorobenzene	8010 (5030)	5	100	3.4	13	5.1	3	
Chloroethane	8010 (5030)	5	97	4.0	14	5.2	3	
Chloroform	8010 (5030)	5	98	6.1	14	6.4	3	
1-Chlorohexane	8010 (5030)	5	104	6.2	14	7.3	3	
2-Chloroethylvinyl ether	8010 (5030)	5	95	6.9	13	4.0	3	
Chloromethane	8010 (5030)	5	93	6.0	14	5.4	3	
Chloromethylmethyl ether	8010 (5030)	25	95	6.0	15	4.9	3	
Chlorotoluene	8010 (5030)	5	93	6.1	15	5.3	3	
Dibromochloromethane	8010 (5030)	5	77	6.5	15	4.2	3	
Dibromomethane	8010 (5030)	5	93	6.3	14	6.0	3	
1,2-Dichlorobenzene	8010 (5030)	5	100	5.3	14	5.7	3	
1,3-Dichlorobenzene	8010 (5030)	5	99	4.7	15	3.9	3	
1,4-Dichlorobenzene	8010 (5030)	5	97	3.9	15	4.9	3	
Dichlorodifluoromethane	8010 (5030)	5	112	4.9	15	5.4	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,1-Dichloroethane	8010 (5030)	5	127	8.2	14	8.1	3	
1,2-Dichloroethane	8010 (5030)	5	126	7.4	15	10.8	3	
1,1-Dichloroethylene	8010 (5030)	5	124	9.2	16	7.0	3	
1,2-Dichloroethene	8010 (5030)	5	130	9.6	17	6.2	3	
Methylene Chloride	8010 (5030)	5	120	6.6	18	6.2	3	
1,2-Dichloropropane	8010 (5030)	5	120	6.2	14	3.5	3	
1,3-Dichloropropylene	8010 (5030)	5	125	13.0	16	9.6	3	
1,1,2,2-Tetrachloroethane	8010 (5030)	5	127	11.2	18	10.8	3	
1,1,1,2-Tetrachloroethane	8010 (5030)	5	112	6.2	19	11.1	3	
Tetrachloroethylene	8010 (5030)	5	115	7.7	20	1.7	3	
1,1,1-Trichloroethane	8010 (5030)	5	137	11.3	21	12.4	3	
1,1,2-Trichloroethane	8010 (5030)	5	130	12.4	23	11.8	3	
Trichloroethylene	8010 (5030)	5	112	7.0	27	5.0	3	
Trichlorofluoromethane	8010 (5030)	5	110	6.6	26	7.9	3	
Trichloropropane	8010 (5030)	5	97	11.4	19	12.6	3	
Vinyl Chloride	8010 (5030)	5	99	10.2	20	13.6	3	
1,2-Dibromoethane (EDB)	8010 (5030)	5	10	10	10	10	3	
Benzene	8020 (5030)	5	120	4.1	15	7.9	3	
Chlorobenzene	8020 (5030)	5	110	3.5	16	5.4	3	
1,2-Dichlorobenzene	8020 (5030)	5	112	5.8	17	6.8	3	
1,3-Dichlorobenzene	8020 (5030)	5	101	4.0	13	7.6	3	
1,4-Dichlorobenzene	8020 (5030)	5	99	6.7	14	5.5	3	
Ethylbenzene	8020 (5030)	5	98	5.5	15	8.2	3	
Toluene	8020 (5030)	5	99	10.0	19	7.7	3	
Xylenes	8020 (5030)	5	97	10.6	20	3.2	3	

- Can be analyzed by 8010 substituting a Halls Detector with an E. C. Detector.

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Acrolein	8030 (5030)	250	101	11.6	11	5.5	3	
Acrylonitrile	8030 (5030)	250	110	12.8	10	3.9	3	
Acetonitrile	8030 (5030)	250	109	12.7	15	4.1	3	
Petroleum Fingerprint	Modified 8015	10	120	6.1	20	7.3	3	
Acrylamide	8015 (5030)	5	127	19.0	30	3.4	3	
2-Butanone (MEK)	8015 (5030)	5	130	18.0	30	6.5	3	
Diethyl ether	8015 (5030)	5	126	16.0	30	2.4	3	
Ethanol	8015 (5030)	5	125	24.0	31	8.4	3	
Ethyl methacrylate	8015 (5030)	5	120	21.0	31	7.3	3	
Isobutyl alcohol	8015 (5030)	5	118	23.0	37	8.1	3	
Isopropyl alcohol	8015 (5030)	5	115	31.0	31	7.6	3	
Methacrylonitrile	8015 (5030)	5	110	26.0	30	7.3	3	
Methyl methacrylate	8015 (5030)	5	126	25.0	23	9.0	3	
4-Methyl-2-pentanone	8015 (5030)	5	121	19.0	26	3.4	3	
Methyl-tert-butyl ether(MTBE)	8015 (5030)	5	131	15.0	21	4.0	3	
Paraldehyde	8015 (5030)	5	96	7.7	35	12.0	3	
Propionitrile	8015 (5030)	5	97	5.7	25	11.7	3	
2-Chlorophenol	8040 (3550)	100	96	2.0	25	6.7	3	
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	8040 (3550)	100	127	6.7	25	6.1	3	
2,4-Dichlorophenol	8040 (3550)	100	125	6.5	30	11.3	3	
2,4-Dimethylphenol	8040 (3550)	100	130	3.2	30	10.0	3	
2,4-Dinitrophenol	8040 (3550)	100	132	1.4	29	9.3	3	
2-Methyl-4,6-dinitrophenol	8040 (3550)	100	140	6.3	25	8.0	3	
2-Nitrophenol	8040 (3550)	100	100	9.0	35	2.9	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
4-Nitrophenol	8040 (3550)	100	97	5.7	25	11.7	3	
Pentachlorophenol	8040 (3550)	100	100	7.6	25	10.3	3	
Phenol	8040 (3550)	100	89	8.0	25	9.9	3	
Tetrachlorophenol	8040 (3550)	100	96	2.0	25	6.7	3	
2,4,6-Trichlorophenol	8040 (3550)	100	125	7.1	31	13.0	3	
Butyl benzyl phthalate	8060 (3550)	100	122	8.1	27	12.3	3	
Bis(2-ethylhexyl)phthalate	8060 (3550)	100	116	8.9	26	11.2	3	
Di-n-Butyl phthalate	8060 (3550)	100	123	3.4	24	10.0	3	
Diethyl phthalate	8060 (3550)	100	116	2.0	24	7.6	3	
Dimethyl phthalate	8060 (3550)	100	128	2.5	22	9.3	3	
Di-n-octyl phthalate	8060 (3550)	100	126	4.0	20	12.0	3	
Aldrin	8080 (3550)	2.5	108	2.2	16	1.4	3	
Alpha-BHC	8080 (3550)	2.0	98	2.4	16	2.0	3	
beta-BHC	8080 (3550)	4.0	78	4.3	25	2.1	3	
gamma-BHC (Lindane)	8080 (3550)	2.0	86	2.6	17	1.5	3	
delta-BHC	8080 (3550)	2.0	108	5.6	19	1.5	3	
Chlordane	8080 (3550)	10	113	5.1	20	1.3	3	
4,4'-DDD	8080 (3550)	5.0	122	7.0	20	9.6	3	
4,4'-DDE	8080 (3550)	5.0	134	6.0	18	7.3	3	
4,4'-DDT	8080 (3550)	10	147	5.3	20	6.4	3	
Dieldrin	8080 (3550)	5.0	119	5.4	21	5.6	3	
Endosulfan I	8080 (3550)	5.0	111	6.1	25	5.0	3	
Endosulfan II	8080 (3550)	10	126	7.7	25	5.1	3	
Endosulfan sulfate	8080 (3550)	15	150	2.2	27	4.5	3	
Endrin	8080 (3550)	5.0	100	3.5	29	6.1	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Endrin aldehyde	8080 (3550)	15	110	4.9	20	7.2	3	
Endrin ketone	8080 (3550)	15	102	5.6	12	5.9	3	
Heptachlor	8080 (3550)	2.5	120	8.0	20	6.6	3	
Heptachlor epoxide	8080 (3550)	5.0	125	7.7	20	6.7	3	
Methoxychlor	8080 (3550)	100	98	8.9	15	8.8	3	
Methyl Parathion	8080 (3550)	100	99	2.9	25	14.2	3	
Toxaphene	8080 (3550)	150	99	10.1	15	8.9	3	
PCB-1016	8080 (3550)	150	97	11.1	16	7.0	3	
PCB-1221	8080 (3550)	150	96	12.2	18	7.5	3	
PCB-1232	8080 (3550)	150	90	13.6	19	6.6	3	
PCB-1242	8080 (3550)	150	91	14.0	20	7.8	3	
PCB-1248	8080 (3550)	150	92	13.0	21	8.5	3	
PCB-1254	8080 (3550)	150	87	12.0	22	9.0	3	
PCB-1260	8080 (3550)	150	88	12.0	26	8.1	3	
Acenaphthene	8100 (3550)	670	124	4.0	15	2.1	3	
Acenaphthylene	8100 (3550)	670	139	4.0	12	7.0	3	
Benzo(a)pyrene	8100 (3550)	1300	126	3.1	12	6.0	3	
Benzo(b)fluoranthene	8100 (3550)	2000	140	2.5	11	5.0	3	
Benzo(k)fluoranthene	8100 (3550)	2000	116	2.0	19	3.1	3	
Benzo(g,h,i)perylene	8100 (3550)	2000	123	4.2	20	2.7	3	
Carbazole	8100 (3550)	670	159	6.1	20	2.1	3	
Chrysene	8100 (3550)	2000	150	7.3	15	7.5	3	
Benzo(a)anthracene	8100 (3550)	2000	124	3.0	19	7.0	3	
Fluoranthene	8100 (3550)	1300	125	3.4	17	3.8	3	
Fluorene	8100 (3550)	1300	127	5.0	17	2.3	3	
Indeno(1,2,3-cd)pyrene	8100 (3550)	2000	130	4.7	19	1.6	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Dibenzo(a,h)anthracene	8100 (3550)	2000	127	4.6	10	2.9	3	
1-Methylnaphthalene	8100 (3550)	670	125	5.3	12	3.0	3	
2-Methylnaphthalene	8100 (3550)	670	116	6.1	15	1.9	3	
Naphthalene	8100 (3550)	670	115	9.0	16	2.7	3	
Phenanthrene	8100 (3550)	1300	109	7.6	19	3.5	3	
Anthracene	8100 (3550)	1300	113	6.6	20	4.6	3	
Pyrene	8100 (3550)	1300	115	6.7	20	7.0	3	
Azinphos methyl	8140 (3550)	200	92	11.0	20	6.9	3	
Bolstar	8140 (3550)	100	94	2.3	10	2.5	3	
Chlorpyrifos	8140 (3550)	25	115	18.9	10	6.0	3	
Coumaphos	8140 (3550)	100	108	15.0	12	7.1	3	
Demeton-O	8140 (3550)	25	100	7.0	22	6.7	3	
Demeton-S	8140 (3550)	50	109	2.3	15	2.5	3	
Diazinon	8140 (3550)	20	99	1.0	15	3.8	3	
Dichlorvos	8140 (3550)	50	109	5.4	15	2.5	3	
Disulfoton	8140 (3550)	20	101	1.4	13	2.5	3	
Ethoprop	8140 (3550)	20	99	102	11	6.0	3	
Fensulfothion	8140 (3550)	100	99	2.3	12	1.5	3	
Fenthion	8140 (3550)	20	96	3.4	9	3.8	3	
Merphos	8140 (3550)	20	96	3.5	7	1.3	3	
Mevinphos	8140 (3550)	20	109	6.2	10	3.9	3	
Naled	8140 (3550)	20	104	3.4	16	5.4	3	
Parathion methyl	8140 (3550)	20	102	2.1	14	6.1	3	
Phorate	8140 (3550)	20	99	1.0	11	1.9	3	
Ronnel	8140 (3550)	20	104	1.4	16	4.9	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Stiophos (tetrachlorvinphos)	8140 (3550)	20	100	2.4	15	3.4	3	
Tokuthion (Prothiofos)	8140 (3550)	20	89	5.9	10	1.1	3	
Trichloronate	8140 (3550)	100	104	1.7	13	2.0	3	
2,4-D	8150	0.5	77	4.0	18	8.9	3	
2,4-DB	8150	0.5	93	3.0	36	11.5	3	
2,4,5-T	8150	0.3	83	4.0	25	10.0	3	
2,4,5-TP (Silvex)	8150	0.1	88	4.0	25	9.7	3	
Dalapon	8150	10	96	13.0	25	11.2	3	
Dicamba	8150	0.1	86	9.0	30	15.0	3	
Dichloroprop	8150	0.5	72	3.0	35	12.3	3	
Dinoseb	8150	0.5	81	3.0	30	10.0	3	
MCPA	8150	10	73	3.0	19	6.8	3	
MCPP	8150	10	97	3.0	30	14.8	3	
Acetone	8240 (5030)	500	139	6.9	35	6.1	3	
Acetonitrile	8240 (5030)	500	140	6.8	36	8.1	3	
Acrolein	8240 (5030)	250	140	9.0	36	7.2	3	
Acrylonitrile	8240 (5030)	250	145	3.4	37	3.9	3	
Allyl chloride	8240 (5030)	250	120	5.0	39	4.0	3	
Benzene	8240 (5030)	5	125	9.9	38	6.6	3	
Bromodichloromethane	8240 (5030)	250	136	10.1	39	7.1	3	
Bromoform	8240 (5030)	5	137	11.0	40	7.2	3	
Bromomethane	8240 (5030)	500	116	11.2	40	7.3	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
2-Butanone (MEK)	8240 (5030)	500	140	10.1	38	9.0	3	
Carbon disulfide	8240 (5030)	50	101	11.1	39	6.1	3	
Carbon tetrachloride	8240 (5030)	50	120	12.2	40	7.2	3	
Chloroethane	8240 (5030)	100	130	11.6	41	3.4	3	
Chlorobenzene	8240 (5030)	50	127	12.0	35	5.4	3	
2-Chloroethylvinyl ether	8240 (5030)	100	125	13.0	35	9.6	3	
Chloroform	8240 (5030)	50	126	12.0	35	7.1	3	
Chloromethane	8240 (5030)	500	127	11.1	40	7.3	3	
Chloropropene	8240 (5030)	250	119	9.8	40	6.9	3	
Dibromomethane	8240 (5030)	250	120	3.6	39	7.4	3	
1,2-Dibromo-3-chloropropane	8240 (5030)	250	118	8.1	21	3.9	3	
1,4-Dichloro-2-butane	8240 (5030)	50	121	4.5	38	6.9	3	
trans-1,4-Dichloro-2-butene	8240 (5030)	250	129	7.0	31	6.7	3	
Dichlorodifluoromethane	8240 (5030)	250	130	8.9	36	7.0	3	
Dibromochloromethane	8240 (5030)	100	136	3.6	35	7.1	3	
1,2-Dichlorobenzene	8240 (5030)	100	125	9.9	40	8.0	3	
1,3-Dichlorobenzene	8240 (5030)	100	131	10.1	32	7.3	3	
1,4-Dichlorobenzene	8240 (5030)	100	124	11.1	30	8.9	3	
1,1-Dichloroethane	8240 (5030)	50	125	13.6	25	8.2	3	
1,2-Dichloroethane	8240 (5030)	50	112	12.9	26	8.6	3	
1,2-Dichloroethene (total)	8240 (5030)	50	115	11.3	35	8.7	3	
1,4-Dioxane	8240 (5030)	1000	117	12.9	37	8.1	3	
1,1-Dichloroethene	8240 (5030)	5	125	12.1	20	6.1	3	
1,2-Dichloropropane	8240 (5030)	5	130	10.2	31	5.1	3	
cis-1,3-Dichloropropene	8240 (5030)	5	140	11.1	45	4.1	3	
trans-1,3-Dichloropropene	8240 (5030)	5	142	6.2	37	3.1	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Ethanol	8240 (5030)	100	109	5.4	26	5.1	3	
Ethyl cyanide	8240 (5030)	1000	116	6.1	12	4.1	3	
Ethylbenzene	8240 (5030)	50	110	5.0	20	5.1	3	
Ethyl methacrylate	8240 (5030)	1000	117	6.7	27	7.1	3	
2-Hexanone	8240 (5030)	500	118	7.7	28	6.2	3	
Isobutyl alcohol	8240 (5030)	1000	120	6.7	29	5.3	3	
Iodomethane	8240 (5030)	100	130	8.9	30	5.0	3	
Methyl Bromide	8240 (5030)	1000	115	8.6	24	6.2	3	
Methyl Chloride	8240 (5030)	1000	102	14.5	35	2.6	3	
Methylene Bromide	8240 (5030)	1000	89	10.2	25	8.1	3	
Methyl methacrylate	8240 (5030)	1000	129	9.9	31	5.6	3	
Methylene chloride	8240 (5030)	250	127	10.1	26	5.7	3	
4-Methyl-2-pentanone	8240 (5030)	500	125	11.1	30	6.1	3	
Pentachloroethane	8240 (5030)	1000	121	12.3	31	7.1	3	
Propionitrile	8240 (5030)	10	130	15.1	32	6.0	3	
Pyridine	8240 (5030)	1000	139	15.0	25	5.3	3	
Styrene	8240 (5030)	100	127	15.6	37	6.3	3	
Tetrachloroethene	8240 (5030)	250	125	12.5	25	5.3	3	
1,1,1,2-Tetrachloroethane	8240 (5030)	250	98	10.1	23	5.7	3	
1,1,2,2-Tetrachloroethane	8240 (5030)	250	101	11.5	24	4.7	3	
Toluene	8240 (5030)	50	115	15.6	24	5.0	3	
1,1,1-Trichloroethane	8240 (5030)	50	115	17.1	26	4.2	3	
1,1,2-Trichloroethane	8240 (5030)	50	115	18.2	27	5.9	3	
Trichloroethene	8240 (5030)	50	117	9.0	21	6.0	3	
Trichlorofluoromethane	8240 (5030)	250	118	11.2	32	7.0	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,2,3-Trichloropropane	8240 (5030)	250	120	13.6	33	7.8	3	
Vinyl acetate	8240 (5030)	500	120	12.6	35	6.9	3	
Vinyl chloride	8240 (5030)	100	116	16.0	41	7.3	3	
Xylenes	8240 (5030)	50	119	17.0	17	8.4	3	
Methyl Iodide	8240 (5030)	1000	131	16.1	19	7.4	3	
Trichloromonofluoromethane	8240 (5030)	250	130	16.3	20	7.0	3	
Acenaphthene	8270 (3550)	170	100	8.0	26	4.1	3	
Acenaphthylene	8270 (3550)	170	109	8.1	30	6.1	3	
Acetophenone	8270 (3550)	850	134	9.0	36	5.4	3	
2-Acetylaminofluorene	8270 (3550)	850	129	10.0	25	6.4	3	
Aldrin	8270 (3550)	170	115	11.0	35	7.3	3	
4-Aminobiphenyl	8270 (3550)	850	120	12.0	35	8.0	3	
Aniline	8270 (3550)	170	135	19.0	35	10.0	3	
Anthracene	8270 (3550)	170	145	20.0	35	11.0	3	
Aramite	8270 (3550)	850	140	25.0	39	9.0	3	
Benzo(a)anthracene	8270 (3550)	170	135	25.0	40	10.0	3	
Benzidine	8270 (3550)	5400	161	31.0	36	11.0	3	
Benzoic acid	8270 (3550)	3300	75	30.0	31	12.1	3	
Benzo(b)fluoranthene	8270 (3550)	170	140	30.0	35	13.6	3	
Benzo(k)fluoranthene	8270 (3550)	170	139	25.0	35	13.7	3	
Benzo(g,h,i)perylene	8270 (3550)	170	140	26.0	34	14.1	3	
Benzo(a)pyrene	8270 (3550)	170	75	27.0	34	15.0	3	
Benzyl alcohol	8270 (3550)	1300	89	27.0	30	18.0	3	
Benzyl chloride	8270 (3550)	170	90	29.0	30	15.0	3	
alpha-BHC	8270 (3550)	170	97	28.0	30	16.0	3	
beta-BHC	8270 (3550)	170	99	29.0	27	17.0	3	
delta-BHC	8270 (3550)	170	135	31.0	29	12.0	3	
gamma-BHC	8270 (3550)	170	114	36.0	30	13.0	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Bis(2-Chloroethoxy)methane	8270 (3550)	170	116	10.0	31	15.0	3	
Bis(2-chloroethyl)ether	8270 (3550)	170	170	20.0	32	15.0	3	
Bis(2-chloroisopropyl)ether	8270 (3550)	170	117	11.7	15	9.0	3	
Bis(2-chloro-1-methylethyl) ether	8270 (3550)	170	120	13.0	25	4.0	3	
Bis(2-ethylhexyl)phthalate	8270 (3550)	170	125	14.0	34	5.6	3	
4-Bromophenyl phenyl ether	8270 (3550)	170	130	12.0	24	6.6	3	
Butyl benzyl phthalate	8270 (3550)	170	136	13.0	23	7.3	3	
Chlordane	8270 (3550)	1300	131	12.0	12	6.4	3	
p-Chloroaniline	8270 (3550)	1300	126	11.0	23	5.1	3	
Dibenzofuran	8270 (3550)	170	125	13.0	20	2.9	3	
2,4-Dichlorophenol	8270 (3550)	170	131	15.0	21	4.0	3	
2,6-Dichlorophenol	8270 (3550)	170	130	18.0	23	9.6	3	
Dieldrin	8270 (3550)	170	121	19.0	26	3.4	3	
Diethylphthalate	8270 (3550)	170	125	20.0	28	5.7	3	
Dimethoate	8270 (3550)	850	135	20.0	21	6.7	3	
p-(Dimethylamino)azobenzene	8270 (3550)	850	140	20.0	25	8.1	3	
7,12-Dimethylamino	8270 (3550)	2000	126	25.0	23	9.0	3	
7,12-Dimethylbenzo(a) anthracene	8270 (3550)	2000	130	21.0	30	9.9	3	
3,3'-Dimethylbenzidine	8270 (3550)	850	110	26.0	30	7.3	3	
alpha,alpha-Dimethyl-phen ethylamine	8270 (3550)	850	120	31.0	31	7.6	3	
2,4-Dimethylphenol	8270 (3550)	170	115	26.0	32	6.1	3	
Dimethylphthalate	8270 (3550)	170	117	27.0	36	7.3	3	
m-Dinitrobenzene	8270 (3550)	850	118	23.0	37	8.1	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
4,6-Dinitro-0-cresol	8270 (3550)	850	108	12.6	30	7.6	3	
4,6-Dinitro-2-methylphenol	8270 (3550)	850	120	21.0	31	7.3	3	
2,4-Dinitrophenol	8270 (3550)	850	125	24.0	29	8.4	3	
2,4-Dinitrotoluene	8270 (3550)	170	126	16.0	30	7.4	3	
2,6-Dinitrotoluene	8270 (3550)	170	130	18.0	30	6.5	3	
Dinoseb	8270 (3550)	3300	127	19.0	30	3.4	3	
Di-n-octyl phthalate	8270 (3550)	170	96	19.0	25	1.2	3	
Diphenylamine(N-nitrosodi - phenylamine	8270 (3550)	850	89	7.4	34	1.6	3	
1,2-Diphenyl hydrazine	8270 (3550)	170	78	16.6	27	12.8	3	
Disulfoton	8270 (3550)	170	80	6.8	21	2.8	3	
Endosulfan I	8270 (3550)	170	88	6.0	14	1.3	3	
Endosulfan II	8270 (3550)	170	99	15.3	22	4.3	3	
Endosulfan Sulfate	8270 (3550)	170	93	18.0	22	4.8	3	
Endrin	8270 (3550)	170	87	15.6	29	2.4	3	
Endrin aldehyde	8270 (3550)	170	90	13.0	20	5.8	3	
Endrin ketone	8270 (3550)	170	66	16.8	30	4.6	3	
Ethyl methacrylate	8270 (3550)	170	87	9.4	24	6.4	3	
Ethyl methane sulfonate	8270 (3550)	850	86	15.4	26	7.3	3	
Ethyl parathion	8270 (3550)	170	112	5.1	20	9.4	3	
Famphur	8270 (3550)	170	103	23.0	28	1.3	3	
Fluoranthene	8270 (3550)	170	84	11.8	29	3.2	3	
Fluorene	8270 (3550)	170	91	13.4	16	5.8	3	
Heptachlor	8270 (3550)	170	89	10.0	24	3.9	3	
Heptachlor epoxide	8270 (3550)	170	91	5.3	14	3.5	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Hexachlorobenzene	8270 (3550)	170	93	10.0	28	14.4	3	
Hexachlorobutadiene	8270 (3550)	170	65	4.0	45	1.9	3	
Hexachlorocyclopentadiene	8270 (3550)	170	79	32.0	12	1.0	3	
Hexachloroethane	8270 (3550)	170	80	2.8	18	2.8	3	
Hexachloropropene	8270 (3550)	850	123	12.6	22	8.0	3	
Hexachlorophene	8270 (3550)	850	106	36.0	24	7.0	3	
Indeno(1,2,3-cd)pyrene	8270 (3550)	850	82	16.0	12	7.0	3	
Isodrin	8270 (3550)	170	116	10.1	25	9.7	3	
Isosafrole	8270 (3550)	170	130	13.0	30	15.2	3	
Isophorone	8270 (3550)	170	92	4.8	24	6.0	3	
Kepone	8270 (3550)	170	110	5.9	20	8.7	3	
3-Methylcholanthrene	8270 (3550)	850	78	3.1	29	10.0	3	
Methacrylonitrile	8270 (3550)	850	112	1.4	27	10.9	3	
Methyl methanesulfonate	8270 (3550)	850	76	15.8	31	11.6	3	
Methapyriline	8270 (3550)	850	100	10.0	35	9.8	3	
2-Methylnaphthalene	8270 (3550)	170	109	3.1	19	6.7	3	
Methyl parathion	8270 (3550)	170	112	6.2	35	7.8	3	
Naphthalene	8270 (3550)	850	81	10.8	32	9.9	3	
1,4-Napthoquinone	8270 (3550)	850	84	1.6	36	10.9	3	
1-Naphthylamine	8270 (3550)	170	94	7.9	35	11.1	3	
2-Naphthylamine	8270 (3550)	850	78	2.9	33	12.2	3	
o-Nitroaniline	8270 (3550)	850	98	5.8	20	5.6	3	
m-Nitroaniline	8270 (3550)	850	71	4.4	35	14.1	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
p-Nitroaniline	8270 (3550)	850	81	1.8	32	15.6	3	
Nitrobenzene	8270 (3550)	170	96	6.7	32	8.8	3	
o-Nitrophenol	8270 (3550)	170	104	28.0	38	16.0	3	
p-Nitrophenol	8270 (3550)	850	70	11.5	10	17.0	3	
4-Nitroquinoline-1-oxide	8270 (3550)	850	93	19.9	38	16.6	3	
N-Nitroso-di-n-butylamine	8270 (3550)	850	91	18.0	35	15.7	3	
N-Nitrosodiethylamine	8270 (3550)	850	102	10.0	36	14.7	3	
N-Nitrosodimethylamine	8270 (3550)	170	107	11.0	28	12.3	3	
N-Nitrosodiphenylamine	8270 (3550)	170	110	12.0	35	13.3	3	
N-Nitrosodipropylamine	8270 (3550)	850	97	13.0	35	14.7	3	
N-Nitrosomethylethylamine	8270 (3550)	850	96	12.0	40	15.6	3	
N-Nitrosomorpholine	8270 (3550)	850	98	19.0	35	18.9	3	
N-Nitrosopiperidine	8270 (3550)	850	97	20.0	25	19.9	3	
N-Nitrosopyrrolidine	8270 (3550)	850	107	7.6	35	7.9	3	
5-Nitro-o-toluidine	8270 (3550)	850	100	9.0	35	2.9	3	
PCB-1016	8270 (3550)	6700	119	12.0	35	4.6	3	
PCB-1221	8270 (3550)	6700	125	16.7	35	5.9	3	
PCB-1232	8270 (3550)	6700	135	6.7	36	6.9	3	
PCB-1242	8270 (3550)	6700	140	6.3	25	8.0	3	
PCB-1248	8270 (3550)	6700	130	4.5	27	8.1	3	
PCB-1254	8270 (3550)	6700	132	1.4	29	9.3	3	
PCB-1260	8270 (3550)	6700	130	3.2	30	10.0	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
Pentachlorobenzene	8270 (3550)	850	125	6.5	30	11.3	3	
Pentachloroethane	8270 (3550)	170	127	6.7	25	6.1	3	
Pentachloronitrobenzene	8270 (3550)	850	120	6.3	27	7.3	3	
Pentachlorophenol	8270 (3550)	850	115	8.9	30	7.5	3	
Phenacetin	8270 (3550)	850	101	8.8	29	3.9	3	
Phenanthrene	8270 (3550)	170	110	7.6	25	7.9	3	
Phenol	8270 (3550)	170	110	9.0	25	10.1	3	
p-Phenylenediamine	8270 (3550)	850	121	7.6	25	3.4	3	
Phorate	8270 (3550)	170	112	2.0	25	5.8	3	
2-Picoline	8270 (3550)	850	96	2.0	25	6.7	3	
Pronamide	8270 (3550)	850	89	8.0	25	9.9	3	
Pyrene	8270 (3550)	170	100	7.6	25	10.3	3	
Pyridine	8270 (3550)	170	97	5.7	25	11.7	3	
Safrole	8270 (3550)	850	96	6.6	25	11.0	3	
Sulfotepp	8270 (3550)	170	97	3.4	30	12.0	3	
Sym-Trinitrobenzene	8270 (3550)	850	96	5.6	40	12.0	3	
1,2,4,5-Tetrachlorobenzene	8270 (3550)	850	96	7.7	35	12.0	3	
2,3,4,6-Tetrachlorophenol	8270 (3550)	850	85	24.0	35	9.0	3	
o-Toluidine	8270 (3550)	850	89	26.0	30	7.6	3	
Toxaphene	8270 (3550)	13000	90	24.0	31	7.6	3	
Thionazin	8270 (3550)	850	102	14.0	27	9.8	3	
1,2,4-Trichlorobenzene	8270 (3550)	170	97	15.0	30	8.8	3	
2,4,5-Trichlorophenol	8270 (3550)	170	100	32.0	28	8.9	3	
0,0,0-Triethylphosphoro- thioate	8270 (3550)	850	113	23.0	25	5.0	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
2,4,6-Trichlorophenol	8270 (3550)	170	112	21.0	36	4.5	3	
4-Chloroaniline	8270 (3550)	170	199	26.0	26	6.7	3	
Chlorobenzilate	8270 (3550)	850	120	30.0	25	4.7	3	
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	8270 (3550)	170	135	32.0	27	4.9	3	
1-Chloronaphthalene	8270 (3550)	170	136	31.0	26	6.3	3	
2-Chloronaphthalene	8270 (3550)	170	140	40.0	30	6.3	3	
2-Chlorophenol	8270 (3550)	170	141	33.0	32	4.5	3	
4-Chlorophenylphenyl ether	8270 (3550)	170	140	23.0	33	8.2	3	
Chrysene	8270 (3550)	170	140	22.0	32	8.1	3	
m-Cresol(3-Methylphenol)	8270 (3550)	850	125	32.0	37	12.9	3	
o-Cresol(2-Methylphenol)	8270 (3550)	170	135	32.0	31	7.8	3	
p-Cresol(4-Methylphenol)	8270 (3550)	170	127	40.0	34	8.4	3	
4,4-DDD	8270 (3550)	170	100	39.0	25	8.9	3	
4,4-DDE	8270 (3550)	170	101	27.0	22	4.9	3	
4,4-DDT	8270 (3550)	170	109	21.0	27	5.2	3	
Diallate	8270 (3550)	850	97	32.0	26	7.2	3	
Dibenzo(a,h)anthracene	8270 (3550)	170	98	39.0	30	6.7	3	
Dibenzofuran	8270 (3550)	170	99	40.0	31	8.0	3	
1,2-Dibromo-3-chloropropane	8270 (3550)	170	89	27.0	21	9.0	3	
1,2-Dibromomethane	8270 (3550)	170	98	17.0	31	5.6	3	
Di-n-butylphthalate	8270 (3550)	170	87	32.0	25	12.0	3	
1,2-Dichlorobenzene	8270 (3550)	170	110	5.2	30	9.6	3	
1,3-Dichlorobenzene	8270 (3550)	170	137	10.0	31	10.1	3	

Parameter	EPA Method (Prep)	Detection Limit(ug/kg)	Accuracy % Recovery	sd	Precision Avg. RPD	sd	Reference	Note
1,4-Dichlorobenzene	8270 (3550)	170	125	11.0	30	11.1	3	
3,3'-Dichlorobenzidine	8270 (3550)	350	127	5.9	30	12.2	3	
Acenaphthene	8310 (3550)	170	124	5.1	25	14.0	3	
Acenaphthylene	8310 (3550)	170	139	8.7	21	11.1	3	
Anthracene	8310 (3550)	170	126	4.0	20	12.0	3	
Benzo(a)anthracene	8310 (3550)	170	135	4.0	21	9.0	3	
Benzo(a)pyrene	8310 (3550)	170	128	2.5	22	9.3	3	
Benzo(b)fluoranthene	8310 (3550)	170	150	4.2	23	6.6	3	
Benzo(g,h,i)perylene	8310 (3550)	170	116	2.0	24	7.6	3	
Benzo(k)fluoranthene	8310 (3550)	170	159	3.0	25	7.3	3	
Chrysene	8310 (3550)	170	110	7.7	25	6.4	3	
Dibenzo(a,h)anthracene	8310 (3550)	170	123	3.4	24	10.0	3	
Fluoranthene	8310 (3550)	170	116	8.9	26	11.2	3	
Fluorene	8310 (3550)	170	122	8.1	27	12.3	3	
Naphthalene	8310 (3550)	170	130	7.0	30	11.0	3	
Phenanthrene	8310 (3550)	170	125	7.1	31	13.0	3	
Pyrene	8310 (3550)	170	126	9.0	30	14.0	3	
Benzal chloride	8120 (3550)	170	112	2.0	25	5.8	3	
Benzotrichloride	8120 (3550)	170	96	2.0	25	6.7	3	
Benzyl chloride	8120 (3550)	170	89	8.0	25	9.9	3	
Hexachlorocyclohexane	8120 (3550)	170	100	7.6	25	10.3	3	
Tetrachlorobenzenes	8120 (3550)	170	97	5.7	25	11.7	3	
Pentachlorohexane	8120 (3550)	170	97	5.7	25	11.7	3	

1. Note: Completeness Data by Method

Organics:

<u>Matrix</u>	<u>Method</u>	<u>%</u>	<u>Matrix</u>	<u>Method</u>	<u>%</u>
Water	501	90	Soil/Sludge	8010	90
Water	502.2	90	Soil/Sludge	8015	90
Water	504	90	Soil/Sludge	Modified 8015	90
Water	515.1	90	Soil/Sludge	8020	90
Water	524.2	90	Soil/Sludge	8030	90
Water	524.1	95	Soil/Sludge	8040	90
Water	531	90	Soil/Sludge	8060	90
Water	601/8010	95	Soil/Sludge	8080	90
Water	8015	95	Soil/Sludge	8100	90
Water	Modified 8015	95	Soil/Sludge	8120	90
Water	602/8020	95	Soil/Sludge	8140	90
Water	603/8030	93	Soil/Sludge	8240	90
Water	604/8040	93	Soil/Sludge	8270	90
Water	606/8060	93	Soil/Sludge	8310	90
Water	608/8080	93	Soil/Sludge	8150	90
Water	610/8100	93			
Water	610/8310	93			
Water	612/8120	93			
Water	614/8140	93			
Water	615/8150	93			
Water	617	93			
Water	619	93			
Water	622	93			
Water	624/8240	95			
Water	625/8270	95			

	<u>Matrix</u>	<u>Method</u>	<u>%</u>
Inorganics:	Water	200-289 (Metals)	98
	Soil/Sludge	6010	95
	Soil/Sludge	7000-7950	95

2. ID = Insufficient Data

3. * - Precision and accuracy data is generated from EPA Method Control data. All other data for the other parameters are generated from historical data and are routinely analyzed.

- References:
- 1) EPA 600/4-79-020, Revised March 1983.
 - 2) SW846, 3rd Edition, November 1986.
 - 3) Federal Register, 40CFR, Part 136, July 1, 1988.
 - 4) EPA 500 Series, Federal Register, 40CFR, Part 141 and 142 Wednesday, July 8, 1987.
 - 5) American Standards for Testing and Materials.
 - 6) NIOSH, 3rd Edition, Volume 1, February 1984.
 - 7) Standard Methods, 16th Edition, 1985.

Accuracy: Represents the average % recovery of spiked samples.

Precision: Represents the average % RPD of duplicate samples.

_____ : % number of valid QC Test
----- x 100
Total number of QC Tests

Detection Limits: Detection limits are determined by using 40 CFR, Part 136, Appendix B. Some detection limits are taken from SW-846, 3rd Edition, November 1986. Detection limits are based upon ideal conditions which represent that best achievable for clean samples. Detection limits will be dependant and vary upon sample matrix and dilutions.

6.0 SAMPLING PROCEDURES

Sampling will be performed in accordance with DER procedures and as outlined in the EPA document entitled "Standard Operating Procedures and Quality Assurance Manual" (dated April 1, 1986) (EPA SOP). This document is available for reference by field personnel. Field personnel will begin sampling at the least contaminated site and proceed to the most contaminated site. Each site sampled will be less contaminated than the next site to follow.

The following procedures will be employed by ATI in the collection of water samples.

6.1 Groundwater

Groundwater may be sampled and collected according to EPA SOP, 1986: Section No. 4.7, Subsection 4.7.2, pg. 1, Subsection 4.7.2, pg.1, Subsection 4.7.5, pg. 3-9, Subsection 4.7.6, pg. 5-6, Subsection 4.7.7, pg. 6-9. Upon arrival at the well-head all vehicles and potential sources of contamination will be located downwind of the well to minimize the possibility of airborne contamination. All sampling equipment will be stored and transported separate from the generator and gasoline supply. The condition of the well will be examined and observations will be recorded on DER Form AP1 (see Figure 6.3). Plastic sheeting will be placed on the ground around the well to help protect sampling equipment from potential contamination.

The well protector will be unlocked and the well cap removed to measure the water level in the well prior to purging and sample collection.

6.1a Water Level Measurements - pH and Conductivity

The meter's probe and cable will be lowered into the well and upon encountering water, the depth to water below the top of the surveyed casing will be recorded. This measurement will then be subtracted from the top of casing elevation to provide the water elevation in the well to the nearest 0.01 foot NGVD. Two measurements of the water level will be made. If the two measurements do not agree within 0.01 foot, the water level will continue to be measured until the results are shown to be reliable or in agreement.

This equipment will be cleaned according to Section B.7.1 (EPA SOP).

Prior to sample collection, the well will be purged. These wells will be pumped with a submersible

pump constructed of stainless steel and a teflon impeller. A check valve is employed to prevent backflow from tubing into the well. It is generally recommended that a minimum of three to five well volumes of water be removed prior to sample acquisition. This technique will be used only as a general guideline. Stabilization of water, pH, Conductivity and Temperature provides a better indication of sample representativeness. The well will be pumped until pH, Conductivity, and Temperature of the water is stabilized, even if removal of more than three to five volumes is required. If stabilization is achieved before removal of three well volumes, three will be removed anyway before collecting samples. The pH, Conductivity, and Temperature of the purged water will be recorded at the start of pumping and then at regular intervals. The sample will be collected when the pH, Conductivity, and Temperature change less than 5% over three consecutive readings. The samples are then collected with a teflon bailer. The water then drains into the appropriate containers from the teflon bailer.

If a well is pumped dry and recovery is too slow to achieve stabilization, the well will be allowed to recover and then pumped dry again. Sample collection will immediately follow this recovery. The maximum time between purging and sampling is < six hours.

If a site is known to be contaminated, the purge water is contained in 55 gallon drums. The client is then responsible for disposal of the purged water contained in these drums. Otherwise, the water is purged onto an impermeable surface.

If solvents or acids are used in the field, the waste is put in containers which are transported back to the lab for proper disposal.

6.1b Calculation of Well Purge Volumes

The minimum volume of water to be removed from the well is calculated by the following equation:

$$V = 0.041d^2h$$

V = Volume (gallons)
d = inside casing diameter (in.)
h = height of standing water in well (ft.) as determined by subtracting the depth to water from the total depth of the well.

Multiply volume (gallons) X the number of well volumes to be removed (three to five)

All bottles are preserved in the laboratory before going to the site. Once the sample is obtained, the pH is checked in the field by using narrow range pH paper on an aliquot of sample poured into a disposable container. If the pH needs adjusting, it is done so in the field by the sampler. The sampler uses the same 10+ of preservative in field as is used at the laboratory.

6.1c Purgeable Organics

An unopened field blank is taken to the sampling site and kept unopened with the samples at all times.

The sampler will make certain that no open solvent bottles (acetone) are in the vicinity of the sample collection.

Purgeable organics are collected in a 40 ml vial. The sample is poured down the interior surface of the vial to be sure that no air passes through the sample. The sample containers are never pre-rinsed with sample water in case a premeasured amount of preservative has been added to this container. The vial is filled to overflowing to prevent volatilization. The sampler will be sure that the surface tensions hold the water in a convex meniscus over the neck of the vial. The teflon side of the septum is placed against this meniscus and cap is screwed on tightly. The sample is then inverted and the cap is lightly tapped on a solid surface. The absence of air bubbles indicates a successful seal. If bubbles are present, the sampler will open vial, add a few more drops of sample and reseal. If necessary, this procedure may be repeated up to 2 to 3 times before starting over with a fresh vial. If preservative has been added, the vials are inverted several times to dissolve and mix preservative. Clients are informed that preservatives have been added when vials are supplied by the laboratory. Each sample is collected in duplicate. The tightness of the seal is double-checked before storing and samples are chilled immediately as well as protected from light.

6.1d Sampling Capabilities

ATI's sampling capabilities are listed in Table 6.1.

6.1e Equipment Used in Sampling

ATI's equipment used in sampling is listed in Table 6.2.

6.1f Preservation and Holding Times

ATI's preservation and holding time table is listed in Table 6.3.

6.2 Wastewater Sampling

Wastewater may be sampled and collected according to EPA SOP, 1986: Section No. 4.5, pages 1-8.

Influent: Influent wastewaters are preferably sampled at points of highly turbulent flow in order to ensure good mixing. The sample collected should be completely untreated.

Effluent: Effluent samples should be collected at the site specified in the permit, or if no site is specified in the permit, at the most representative site downstream from all entering wastewater streams prior to discharge into the receiving waters.

6.2a Automatic Samplers

General: Automatic samplers may be used when several points are to be sampled at frequent intervals or when a continuous sample is required.

The sampler is designed to automatically collect and preserve samples from a liquid source. The sampler is suitable for collection of conventional and toxic pollutants and suspended solids sampling. In the composite mode, samples may be collected in a 2½ gallon glass, or 3 gallon polyethylene composite container. In the discrete mode, samples may be collected in 24 individual 350 ml glass or 1000 ml polyethylene sample bottles. The sample container or bottles are located in an insulated double walled base section, which is an integral part of the sampler.

The sampler collects samples on either a timed cycle basis, or in proportion to flow rate when used in conjunction with a flowmeter. In the timed cycle mode, the interval between samples is controlled by an integral quartz crystal clock. The sample interval may be set from 1 to 9,999 minutes, in one minute increments. In the flow proportional mode, the interval between samples may be set from 1 to 9,999 flow pulses, in one pulse increments, where each pulse represents a specific flow volume interval. In both modes, the number of minutes or flow pulses remaining until the next sample is shown on the control display.

The sampler utilizes a high speed peristaltic pump for collection of the sample liquid. The pump body is constructed of impact and corrosion resistant plastic. Pump tubing is held firmly in place by the pump body halves - no clamps are required. The intake line is air purged before and after each sample. The sample is under pumped flow at all times from the source stream to the sample container.

6.2b Manual Sampling

Manual sampling is usually used for collecting grab samples and/or for immediate in-situ field analysis.

The best method to manually collect a sample is to use the actual sample container which will be used to transport the sample to the laboratory. This eliminates the possibility of contaminating the sample with an intermediate collection container. The actual sample container must always be used for collecting samples for oil and grease and bacterial analyses.

Samples are manually collected by completely submersing the sample container under water in inverted position and returning it to upright position while still submerged. The container will be pointed facing upstream. The container should be rinsed with this procedure at least twice before the sample is collected. If the water is shallow or preservatives have been added, samples must be collected using a clean glass dipper. The sampler will take care not to bias a sample by collecting from the top of a body of water. The sampler is aware that the most desirable location is a well-mixed zone.

6.2c Special Sample Collection Procedures

Bacterial: Samples for bacterial analysis will always be collected directly into the prepared glass or plastic sample bottle. The sample bottle should be kept unopened until it is to be filled.

Immiscible Liquids/Oil and Grease: Oil and grease may be present in wastewater as a surface film, an emulsion, a solution, or as a combination of these forms. The most desirable sampling location is the point where greatest mixing is occurring.

Purgeable Organic Compounds Analyses (VOA):
Will be collected as described in Section 6.0, subsection 6.1c.

6.3 Surface Water Sampling

Surface water may be sampled and collected according to EPA SOP, 1986: Section No. 4.5, pg. 1-12.

The equipment used for surface water sampling is not depth specific (Sampling Equipment - Table 6.2).

The sampler must be sure that the sample is representative of the site in question. Care is taken not to disturb the bottom sediment while surface water samples are being collected. Sample container is always pointed upstream.

If the water is deep enough, the samples are collected by inverting an open sample bottle and completely submerging it in an inverted position. The bottle is then returned to an upright position thus allowing sample water to flow into the bottle, while container is still submerged. Once the bottle is filled, about $\frac{1}{2}$ " of water is poured out for the addition of preservative and airspace (except trihalomethanes and volatiles).

6.3a Trace Organic Compounds and Metals

Since trace organic compounds and metals are usually found in extremely low concentrations in ambient waters, the possibility of contamination is greater.

The above equipment is acceptable for collecting water samples from streams for trace organic compounds and metals analyses.

6.3b Bacterial

Samples for bacteriological examination must be collected in bottles properly sterilized and protected against contamination. The preferable method is to scoop up the water with the open bottle just below the surface.

6.3c Purgeable Organic Compounds Analyses (VOA)

Collected as described in Section 6.0, Subsection 6.1c.

6.4 Potable Water Sampling

Potable water may be sampled and collected according to EPA SOP, 1986: Section No. 4.8, pg. 1-2.

Potable water taken from wells with in-place plumbing and drinking water wells are collected from the nearest cold water tap to the pump. The tap is turned on to a flow rate of approximately 500 ml/min and the water collected is free of any screens, aerators, filters or other devices. The pump type and pipe construction is noted on the field sheet. When purging continuously running pumps, unknown well volumes are purged for at least 15 minutes at maximum velocity or the volume of the holding tank. When purging intermittently running pumps, unknown well volumes should be purged for at least 15 minutes, with stabilization of field parameters at 5 minute intervals.

Samples are collected directly into the appropriate sample container. The bottle is held in one hand and the cap in the other, using care not to touch the inside of the cap. The faucet should not touch the inside of the bottle. When sampling at a water treatment plant, samples are collected from both the raw water supply and after chlorination.

6.5 Soil Sampling

Soil may be sampled and collected according to EPA SOP, 1986: Section No. 4.9, pg. 1-4.

Disturbed portions of soil samples in auger buckets (top 1-2" layer) are discarded and not taken as part of the sample. When sampling surface soils, surface debris should be cleared with an appropriate implement before sampling.

Soil samples will be collected in accordance with EPA Region IV SOP/QAM, 1986. A stainless steel auger will be employed when analyses for volatiles are to be performed, the sample is removed from the auger and immediately placed in VOC vial so that no headspace is left in the container. The sample is then placed in a cooler containing ice. Samples for all other analyses will be composited in a stainless steel mixing bowl. The composite is mixed and the sample is then poured into a wide mouth jar with teflon lined caps. The samples are then placed in a cooler containing ice.

All equipment used to collect soils will be decontaminated according to Section 6.8b.

6.6 Landfills/Hazardous Waste Sites

Landfills/hazardous waste sites may be sampled and collected according to EPA SOP, 1986: Section No. 4.10, pg. 1-2.

These will be collected according to the procedures described in Section 6.1, Subsections 6.1a-6.1f (Groundwater Sampling).

6.7 Waste Sampling

Waste may be sampled and collected according to EPA SOP, 1986: Section No. 4.11, pg. 1-7.

6.7a Drums

Samples from drums will be collected using the equipment described in Table 6.2. The glass tube is inserted into the drum opening as far as possible. The open end is sealed either with the thumb or a rubber stopper to hold the sample in the tube while removing it from the container. The sample is placed in the appropriate container and the procedure is repeated until adequate sample is collected.

Table 6.1
 Sampling Capabilities

Parameter Group	Sample Source				
	Drinking Water	Surface Water	Ground Water	Sediment Sludge	Soil
Volatile Organics	X	X	X	X	X
Semivolatiles	X	X	X	X	X
Pesticides, Herbs, PCBs	X	X	X	X	X
PAH	X	X	X	X	X
Chlorinated Hydrocarbons	X	X	X	X	X
Trace Metals	X	X	X	X	X
Nutrients	X	X	X	X	X
Demands: BOD, COD	X	X	X		
TOC	X	X	X	X	X
Cyanide	X	X	X	X	X
Microbiologicals	X	X	X		
Alkalinity		X	X		
Bromine		X	X		
Bromide		X	X		
Bromates					
Chloride	X	X	X	X	X
Fluoride	X	X	X	X	X
Hardness	X	X	X		
TSS, TDS, DO, pH	X	X	X		
Temperature, Specific Conductance	X	X	X		
Sulfate	X	X	X	X	X
Nitrate	X	X	X	X	X
Residual Chlorine	X	X	X		
Oil & Grease		X	X		
TPH		X	X	X	X
Phenols		X	X	X	X
Elemental Phosphorous		X	X	X	X
Dissolved Silica		X	X		
Sulfide		X	X	X	X
Surfactants	X	X	X		
Corrosivity		X	X	X	X
Ignitability, Reactivity		X	X	X	X
Odor	X	X	X		
Taste		X	X		
Salinity		X	X		
Turbidity	X	X	X		
TOH		X	X	X	X

Table 6.2

Sampling Equipment - Types and Uses

Equipment Type & Construction Material	Use	Permissible Parameter Group
<u>Water Sampling</u>		
<u>Groundwater</u>		
1) 2 - 2" submersible stainless steel and teflon check valve to prevent backflow	Purging only Wells > 30'	All Parameters
2) 2 - 4" submersible stainless steel and teflon check valve to prevent backflow	Purging only Wells > 30'	All Parameters
3) 2" bladder pump stainless steel and silicone tubing teflon tubing for organics	Purging & sampling	All Parameters If not dedicated must be cleaned between wells
4) 1- Peristaltic Silicone tubing (dedicated) teflon if purging for organics	Purging Sampling	All Parameters Demands/Metals/ Classic Inorganic Non-metals
5) Bailers Teflon	Sampling Purging	All Parameters All Parameters
Disposable Bailers Polyethylene	Sampling Metals and Inorganic Non-metals	Dedicated to one well then "disposed"
<u>Wastewater</u>		
1) Automatic Sampler glass container and polyethylene containers	Collecting Sample	All Parameters
<u>Surface Water</u>		
1) LaMotte Water Sampler Model JT-1 (Rubber & Acrylic)	Sampling	Inorganics

Equipment Type	Use	Permissible Parameter Group
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Surface Water (cont'd)

2) Subsurface (Borosilicate glass container)	Sampling	Organics
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Drinking Water

Direct collection in sample bottles

Field

1) 3 - pH Meters	Well pH	All Parameters
2) 3 - Conductivity meter	Well Conductivity	All Parameters
3) Temperature	Well Temperature	All Parameters
4) 2 - Water level	Well Depth	All Parameters
5) 2 - DO meter		All Parameters
6) Auto Samplers With silicone tubing	Composite Sampling	Inorganics

Hazardous Waste

Drum's Soda lime glass coliwasa tubes or drum thief tubes (dedicated)	Hazardous Waste Drums	All Parameters
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**Solid Sampling
Sediments/Soils**

1) Auger-stainless steel	Sampling	All Parameters
2) Mixing tray & scoop stainless steel	Compositing	All Parameters VOC's will not be homogenized or composited

Table 6.2 (Continued)
Sampling Equipment - Types and Uses

<u>Equipment Type</u>	<u>Use</u>	<u>Permissible Parameter Group</u>
<u>Miscellaneous</u>		
Century Model 88 OVA	Organic Vapor	All Parameters
Latex Gloves	All sampling	
Tirex suit	Hazardous waste sampling	
Respirator	Hazardous waste sampling	
Nitrile & Latex gloves	Hazardous waste sampling	
<u>Transport Equipment</u>		
Trailer	Transport Field Equipment	
Truck	Generator & Gasoline	

* The only dedicated equipment ATI employs is the disposable bailer.

The rope of the LaMotte Model JT-1 water sampler is calibrated in one foot increments. A tape measure is used to measure between graduations. Construction is all stainless steel, rubber and plastic on the surface coming into contact with the inorganic sample.

The Century model 88 OVA is calibrated internally on the high and low end prior to each usage. Weekly external calibration is checked using a 9.7 ppm methane and a 945 ppm methane standard. The instrument response is checked using a 101 ppm benzene standard weekly. Every 6 months the instrument is returned to the factory for servicing and recalibration if necessary. The filters are replaced if background exceeds 10 ppm.

TABLE 6.3

REQUIREMENTS FOR SAMPLE CONTAINERS, PRESERVATION PROCEDURES
 AND MAXIMUM HOLDING TIMES OF WATER SAMPLES

Test	Container(a)	Preservation(b)	Maximum Holding Time(c)
Acidity	P,G	Cool, 4°C	14 days
Alkalinity	P,G	Cool, 4°C	14 days
Ammonia	P,G	Cool, 4°C H ₂ SO ₄ to pH<2	28 days
Coliform, fecal and total	P,G	Cool, 4°C 0.008% Na ₂ S ₂ O ₃ *	6 hours
Fecal Streptococci	P,G	Cool, 4°C 0.008% Na ₂ S ₂ O ₃ *	6 hours
Biochemical Oxygen Demand	P,G	Cool, 4°C	48 hours
Bromide	P,G	None required	28 days
Chemical Oxygen Demand	P,G	Cool, 4°C H ₂ SO ₄ to pH<2	28 days
Chloride	P,G	None required	28 days
Chlorine, total residual	P,G	None required	Analyze Immediately
Color	P,G	Cool, 4°C	48 hours
Cyanide, total and amenable	P,G	Cool, 4°C NaOH to pH>12 0.6g Ascorbic Acid	14 days
Dissolved Oxygen Proble	G bottle & top	None required	Analyze Immediately
Winkler	G bottle & top	Fix on site and store in dark	8 hours

TABLE 6.3 (Continued)

Test	Container(a)	Preservation(b)	Maximum Holding Time(c)
Fluoride	P	None required	28 days
Hardness	P,G	HNO ₃ to pH<2 or H ₂ SO ₄ to pH<2	6 months
Hydrogen ion (pH)	P,G	None Required	Analyze Immediately
Kjeldahl and organic nitrogen	P,G	Cool, 4°C H ₂ SO ₄ to pH<2	28 days
Chromium VI	P,G	Cool, 4°C	24 hours
Mercury	P,G	HNO ₃ to pH<2	28 days
Metals except above	P,G	HNO ₃ to pH<2	6 months
Nitrate	P,G	Cool, 4°C	48 hours
Nitrate-nitrite	P,G	Cool, 4°C H ₂ SO ₄ to pH<2	28 days
Nitrite	P,G	Cool, 4°C	48 hours
Purgeables (Halocarbons and Aromatics)	G, Teflon-Lined Septum	Cool, 4°C Add 1+1 HCL to pH =2**	14 days
Oil and Grease	G	Cool, 4°C H ₂ SO ₄ to pH<2	28 days
Purgeables (Acrolein ⁺⁺⁺ and Acrylonitrile)	G, Teflon-Lined Septum	Cool, 4°C 0.008% Na ₂ S ₂ O ₃ *	14 days

TABLE 6.3 (Continued)

Test	Container(a)	Preservation(b)	Maximum Holding Time(c)
Organic Carbon	P,G	Cool, 4°C HCL or H ₂ SO ₄ to pH<2	28 days
Orthophosphate	P,G	Filter on site Cool, 4°C	48 hours
Phenols	G	Cool, 4°C H ₂ SO ₄ to pH<2	28 days
Phosphorus (elemental)	G	Cool, 4°C	48 hours
Phosphorus, total	P,G	Cool, 4°C H ₂ SO ₄ to pH<2	28 days
Alpha, beta and radium	P,G	HNO ₃ to pH<2	6 months
Residue, total	P,G	Cool, 4°C	7 days
Residue, filter- able	P,G	Cool, 4°C	7 days
Residue, non- filterable	P,G	Cool, 4°C	7 days
Residue, settle-	P,G	Cool, 4°C	48 hours
Residue, volatile	P,G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific conductance	P,G	Cool, 4°C	28 days
Sulfate	P,G	Cool, 4°C	28 days

TABLE 6.3 (Continued)

Test	Container(a)	Preservation(b)	Maximum Holding Time(c)
Sulfide	P,G	Add 2ml zinc-acetate plus NaOH to pH>9	7 days
Sulfite	P,G	None required	Analyze Immediately
Surfactants	P,G	Cool, 4°C	48 hours
Temperature	P,G	None required	Analyze Immediately
Turbidity	P,G	Cool, 4°C	48 hours
Extractables - 600 Series:			
Benzidines	Amber G, Teflon-Lined Cap	Cool, 4°C 0.008% Na ₂ S ₂ O ₃ * Adjust pH 2 to 7 with H ₂ SO ₄	7 days (until extraction) 7 days (after extraction if stored under an inert atmosphere.)
Phenols PAH's TCDD B/N acids Haloethers Phthalate Esters Nitrosamines ⁺ Pesticides & PCB's ⁺⁺ Nitroaromatics & Isophorone Chlorinated Hydrocarbons	Amber G, Teflon-Lined Cap	Cool, 4°C 0.008% Na ₂ S ₂ O ₃ *	7 days (until extraction) 40 days (after extraction)

(End of Extractables - 600 Series)

TABLE 6.3 (Continued)

Test	Container(a)	Preservation(b)	Maximum Holding Time(c)
Extractables - 8000 Series:			
PAH's TCDD Nitrosamines Haloethers B/N acids	Amber G, Teflon-Lined Cap	Cool, 4°C 0.008% Na ₂ S ₂ O ₃ *	7 days (until extraction) 40 days (after extraction)
Benzidine	G, Teflon- Lined Cap	Cool, 4°C 0.008% Na ₂ S ₂ O ₃ *	7 days (until extraction) 7 days (after extraction)
Phthalate Esters	G, Teflon- Lined Cap	Cool, 4°C	7 days (until extraction) 40 days (after extraction)
PCB's, Acrylonitrile	G, Teflon- Lined Cap	Cool, 4°C	7 days (until extraction) 40 days (after extraction)
Total Organic Halogens	G, Teflon- Lined Cap	Cool, 4°C H ₂ SO ₄ to pH<2	7 days
Pesticides	G, Teflon- Lined Cap	Cool, 4°C pH 5-9	7 days (until extraction) 40 days (after extraction)
Chlorinated Hydrocarbons	G, Teflon- Lined Cap	Cool, 4°C	7 days (until extraction) 40 days (after extraction)

(End of Extractables - 8000 Series)

TABLE 6.3 (Continued)
 REQUIREMENTS FOR SAMPLE CONTAINERS AND MAXIMUM
 HOLDING TIMES OF SEDIMENT AND SOIL SAMPLES

Test	Container(d)	Preservation(b)	Maximum Holding Time(c)
Volatile Organics	G,V, 4W	Cool, 4°C	14 days
Semivolatile Organics	G, 8WT	Cool, 4°C	14 days (until extraction) 40 days (after extraction)
Total Metals except mercury & chromium IV	G, Pl, 8W	Cool, 4°C	6 months
Chromium IV	G, Pl, 8W	Cool, 4°C	24 hours
Mercury	G, Pl, 8W	Cool, 4°C	28 days

Adapted from Table 4.1 in test methods for Evaluating Solid Waste
 (SW-846, 3rd Edition, EPA, November 1986.

TABLE 6.3 (Continued)

APPROVED WATER PROCEDURES, CONTAINERS, PRESERVATION AND
 HOLDING TIMES FOR PARAMETERS NOT FOUND IN 40 CFR, 136

Test	Container(d)	Preservation(b)	Maximum Holding Time(c)
Bromine	Pl, G	None required	Analyze immediately
Bromates	Pl, G	Cool, 4°C	30 days
Chlorophylls	Pl, G(2)	14d in dark	30 days (2)
Corrosivity (CaCo3 Stability, Langelier Index)	Pl, G	Cool, 4°C(3)	48 hours(3)
Salinity	G, Wax seal	Analyze immediately or use wax seal	30 days(4)
Taste	G only	Cool, 4°C	24 hours
Transparency	-----	-----	Analyze in-situ
Un-ionized Ammonia	Pl, G	Cool, 4°C Na ₂ S ₂ O ₃ (10)	8 hours unpreserved 28 days preserved (12)
TRPH	G	pH < 2 HCl Cool 4°C	28 days

NOTES AND KEY

Notes:

- (a) Polyethylene (P) or Glass (G).
- (b) Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection, if possible. Aliquots of the composite, which would require multiple preservatives, should be preserved only by maintaining at 4°C until compositing and sample splitting is completed.
- (c) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.
- (d) (G) Glass, (V) 40 ml vial (4W) 4 oz. widemouth with teflon/silicone septum (1)
(8WT) 8 oz. widemouth with teflon lined cap, (Pl) Plastic
(8W) 8 oz. widemouth
- + Nitrosamines: If N-nitrosodiphenylamine is to be determined, the pH is adjusted to a pH 7-10.
- ++ Pesticides & PCB's: If the samples are not extracted within 72 hours the pH is adjusted to 5-9 with NaOH or H₂SO₄.
- +++ Acrolein: pH must be adjusted to 4-5.
- * Required if residual chlorine present.
- ** Required for aromatics only.
- (1) Sample should not be homogenized (mixed) prior to filling container. Container should be filled by packing as much sample into it leaving minimal headspace.
- (2) Collect samples in opaque bottles and process under reduced light. Samples on filter taken from water having pH 7 or higher may be placed in airtight plastic bags and stored frozen for up to three weeks. Samples from acidic water must be processed promptly to prevent chlorophyll degradation.
- (3) Temperature and pH must be measured on site at the time of sample collection. 48 hours is the maximum time for laboratory analysis of total alkalinity, calcium oil and total solids.
- (4) The electrometric and hydrometric methods are suited for field use. The argentometric is suited for laboratory use. Sample for laboratory analysis, when properly sealed with paraffin waxed stopper, may be held indefinitely. The maximum holding time of 30 days is recommended as a practical regulatory limit.
- (5) The results of the measurements of pH, temperature, salinity (if applicable) and the ammonium ion concentration are used to calculate the concentration of ammonia in the unionized state. Temperature, pH and salinity must be measured on site at

the time of sample collection. Laboratory analysis of the ammonium ion concentration should be conducted within eight hours of sample collection. If prompt analysis of ammonia is impossible, preserve samples with H_2SO_4 to pH between 1.5 and 2. Acid-preserved samples, stored at 4°C, may be held up to 28 days for ammonia determination. Sodium thiosulfate should only be used if fresh samples contain residual chlorine.

Key:

$Na_2S_2O_3$	=	Sodium Thiosulfate
H_2SO_4	=	Sulfuric Acid
HNO_3	=	Nitric Acid
NaOH	=	Sodium Hydroxide
HCl	=	Hydrochloric Acid
PCB	=	Polychlorobiphenyl
PAH	=	Polynuclear Aromatic Hydrocarbons
TCDD	=	2,3,7,8 - Tetrachlorodibenzo-p-Dioxin
B/N Acids	=	Base/Neutrals and Acids

6.8 In-House Decontamination and Cleaning Procedures for Field Equipment

All equipment will be precleaned prior to going to the site according to EPA SOP, Appendix B, in a contaminant-free room designed for this cleaning. This will assure that sufficient clean equipment will be available for an entire study without the need for field cleaning. Heavily contaminated equipment will be cleaned in the laboratory and not in the field. All cleaning is documented in a hardbound laboratory notebook, with the date, time and type of equipment cleaned.

6.8a In-house Cleaning Procedures for Teflon or Glass Field Sampling Equipment Used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses

1. Equipment will be washed thoroughly with Liquinox and hot water using a brush to remove any particulate matter or surface film.
2. The equipment will be rinsed thoroughly with hot tap water.
3. Rinse equipment with at least a 10 percent nitric acid solution. HNO_3 will be used only if trace metals are to be sampled. The acid is not used on stainless steel equipment.
4. Rinse equipment thoroughly with deionized water.
5. Rinse equipment twice with pesticide grade isopropanol and allow to air dry for as long as possible.
6. Rinse with analyte-free water and allow to dry in contaminant-free environment.
7. Wrap equipment completely with aluminum foil to prevent contamination during storage and/or transport to the field.

When this sampling equipment is used to collect samples that contain oil, grease or other hard to remove materials, it may be necessary to rinse the equipment several times with pesticide-grade acetone or hexane to remove the materials before proceeding with Step 1. In extreme cases, it may be necessary to steam clean the field equipment before proceeding with Step 1. If the field equipment cannot be cleaned utilizing these procedures, it should be discarded.

6.8b In-house Cleaning Procedures for Stainless Steel or Metal Sampling Equipment Used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses for Soil

1. Wash equipment thoroughly with Liquinox and hot water using a brush to remove any particulate matter or surface film.
2. Rinse equipment thoroughly with hot tap water.
3. Rinse equipment thoroughly with deionized water.
4. Rinse equipment twice with solvent and allow to air dry for at least 24 hours in a contaminant-free environment.
5. Final rinse with analyte-free water.
6. Wrap equipment completely with aluminum foil to prevent contamination during storage and/or transport to the field.

When this sampling equipment is used to collect samples that contain oil, grease or other hard to remove materials, it may be necessary to rinse the equipment several times with pesticide-grade acetone or hexane to remove the materials before proceeding with Step 1. In extreme cases, when equipment is painted, badly rusted, or coated with materials that are difficult to remove, it may be necessary to steam clean, wire brush, or sandblast equipment before proceeding with Step 1. This equipment will never be used to sample for trace contaminants. Any stainless steel sampling equipment that cannot be cleaned using these procedures will be discarded.

6.8c Well Sounders or Tapes Used to Measure Groundwater Levels

1. Wash with laboratory detergent and hot tap water.
2. Rinse with tap water.
3. Rinse with analyte-free water.
4. Equipment should be placed in a polyethylene bag or wrapped with polyethylene film to prevent contamination during storage or transit.

6.8d Teflon Sample Tubing

This cleaning procedure is intended for use in the laboratory or office and should not be attempted in the field. We recommend that enough (precut and precleaned lengths) Teflon tubing for purging or sampling be brought to the field as will be needed. After the sampling event, the hoses can be

transported back to the main office to be properly decontaminated in a relatively clean environment. The reagents needed for this procedure are listed below. These are the same reagents used for field decontamination, except for (the availability of) hot water:

- Use an appropriate laboratory grade detergent (Alconox, Liquinox, Acationox, Micro), that is free of the analyte(s) of interest,
 - tap of potable water,
 - 1 + 1 HNO₃ (10%-15% nitric acid in DI water),
 - pesticide grade methanol or isopropanol,
 - analyte-free water, and
 - aluminum foil.
- 1) The exterior of the tubing must be decontaminated first, using the above listed reagents. In a stainless steel sink (or equivalent of non-contaminating material) soak the Teflon tubing in hot, soapy water and use a brush to remove any particulates, if necessary. Take a small bottle brush and clean the inside of the tubing ends where the barbs are to be inserted. Rise tubing exterior and ends liberally with tap water. Rinse tubing surfaces and ends with nitric acid, then tap water, methanol or isopropanol, and finally analyte-free water.
 - 2) Place tubing on fresh aluminum foil. Connect all of the precut lengths of Teflon hose that were used on site with Teflon inserts or barbs.
 - 3) Using a field-type peristaltic pump, assemble the system used in the field but use a larger size bottle having the same cap size (2-liter) as the collecting bottle.
 - 4) Pump copious amount of hot, soapy water through the connected lengths. Follow this with tap water, then nitric acid, then more tap water, then methanol or isopropanol, and finally analyte-free water. During the nitric acid and solvent rinses, turn the pump off and allow the reagents to remain in the tubing for 15 minutes, then continue with final steps. Pumping one or two liter (each) of the nitric acid and solvent should be sufficient, depending on the inside diameter of the hose. Leave the Teflon inserts or barbs between the precut lengths and cap or connect the remaining ends.
 - 5) After the interior has been sufficiently cleaned, the exterior will need a final rinse with analyte-free water. The connected lengths should then be wrapped in aluminum foil and stored in a

clean, dry area until next use. Documentation for this cleaning is to be completed in a bound notebook.

6.8e Cleaning of Bailers

1. All parts of bailer are cleaned with hot water and liquinox.
2. Rinse with tap water three times or until all soap is gone.
3. Rinse with 1:1 HCl solution.
4. Rinse with tap water three times.
5. Rinse with 1:1 HNO₃ solution.
6. Rinse with tap water three times.
7. Rinse with nanograde isopropanol.
8. Rinse with organic-free water.
9. Allow to air dry in contaminant-free area.
10. Wrap in aluminum foil until use.

6.9 Field Decontamination and Cleaning Procedures for Field Equipment

6.9a Field Cleaning Procedures for Teflon or Glass Field Sampling Equipment Used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses

1. Equipment will be washed thoroughly with laboratory detergent (Liquinox oralconox) and water using a brush to remove any particulate matter or surface film.
2. The equipment will be rinsed thoroughly with hot tap water.
3. Rinse equipment with at least a 10 percent nitric acid solution. HNO₃ will be used only if trace metals are to be sampled. The acid is not used on stainless steel equipment.
4. Rinse equipment thoroughly with deionized water.
5. Rinse equipment twice with pesticide grade isopropanol.
6. Rinse thoroughly with organic-free water and allow to air-dry as long as possible. Do not rinse with deionized or distilled water.
7. Wrap equipment completely with aluminum foil to prevent contamination during storage and/or transport to the field.

6.9b Field Cleaning Procedures for Stainless Steel or Metal Sampling Equipment Used for the Collection of Samples for Trace Organic Compounds and/or Metals Analyses for Soil

1. Wash equipment thoroughly with laboratory detergent (Liquinox oralconox) and water using a brush to remove any particulate matter or surface film.
2. Rinse equipment thoroughly with tap water.
3. Rinse equipment thoroughly with deionized water.
4. Rinse equipment twice with pesticide grade or nanograde isopropanol and allow to air dry for at least 24 hours.
5. Wrap equipment completely with aluminum foil to prevent contamination during storage and/or transport to the field.
6. Rinse the stainless steel or metal sampling equipment thoroughly with tap water in the field as soon as possible after use.

6.9c Well Sounders or Tapes Used to Measure Groundwater Levels

1. Wash with laboratory detergent and tap water.
2. Rinse with tap water.
3. Rinse with deionized water.
4. Equipment should be placed in a polyethylene bag or wrapped with polyethylene film to prevent contamination during storage or transit.

6.10 Sample Containers

The following containers are bought precleaned. A certificate of analysis is obtained from the supplier and kept on record.

6.10a Volatile Organics

Bottle type: 40 ml vial/teflon lined septum, 3 oz. soil jar with teflon cap.

1. Vials, septa and caps are washed in laboratory grade detergent.
2. Rinsed three (3) times with distilled water.
3. Rinsed three (3) times with ASTM Type I water.
4. Oven dried for 1 hour at 125°C.
5. Stored in contaminated free area.

6.10b Metals & General Inorganic Parameters

Bottle type: 16 oz. polyethylene bottle and lid.

1. Washed both bottle and cap with laboratory grade detergent.
2. Rinsed both with HNO_3 solution.
3. Rinsed three (3) times with deionized water.
4. Dried in contaminant free environment.
5. Capped bottles and stored in contaminant free area.

The following containers are cleaned in the laboratory according to the following protocol.

6.10c Extractable Organics

Bottle type: 1 liter Amber/teflon lined caps

1. Wash bottle and cap in laboratory grade detergent.
2. Rinse 3 times with distilled water.
3. Rinse bottle and caps with pesticide-grade isopropanol.
4. Rinse with distilled water.
5. Store in contaminant free area.

6.10d Sludge, Soil, and Sediment for all Parameters
(excluding purgeables)

Bottle type: 32 oz. clear widemouth, 16 oz. clear wide mouth with teflon lined caps.

1. Wash bottles and jars, Teflon liners, and caps in hot tap water and laboratory detergent.
2. Rinse three times with tap water.
3. Rinse with nitric acid solution.
4. Rinse three times with deionized water.
5. Rinse bottles, jars, and liners (not caps) with solvent.
6. Oven dry bottles, jars, and liners at 125°C. Allow to cool.
7. Place liners in caps and cap containers.
8. Store containers in contaminant-free area.

6.11 Sample Documentation and Identification

Proper and consistent field labeling and documentation of samples is necessary to ensure that the samples have been properly transported, that the samples have arrived at the laboratory within a specified time limit.

6.11a Field Documentation

<u>Document</u>	<u>Purpose</u>
Field Equipment log (pH, and Conductivity)	Record of calibration. (Figures 6.4 & 6.5)
Field Data Form (AP1)	Record of Field data (Figure 6.3)
Sample Seal	Preserves sample integrity (Figure 6.6)
Sample label/preservation noted	Identifies sample (Figure 6.6)
Chain of Custody	Record of possession of samples from collection to delivery to lab (Figure 6.7)

Field Equipment Log: For each item of field equipment, a calibration log is maintained. The log documents calibration checks and readings. These are maintained in a bound waterproof logbook.

Also, a logbook is kept in the lab to document maintenance and service of all equipment.

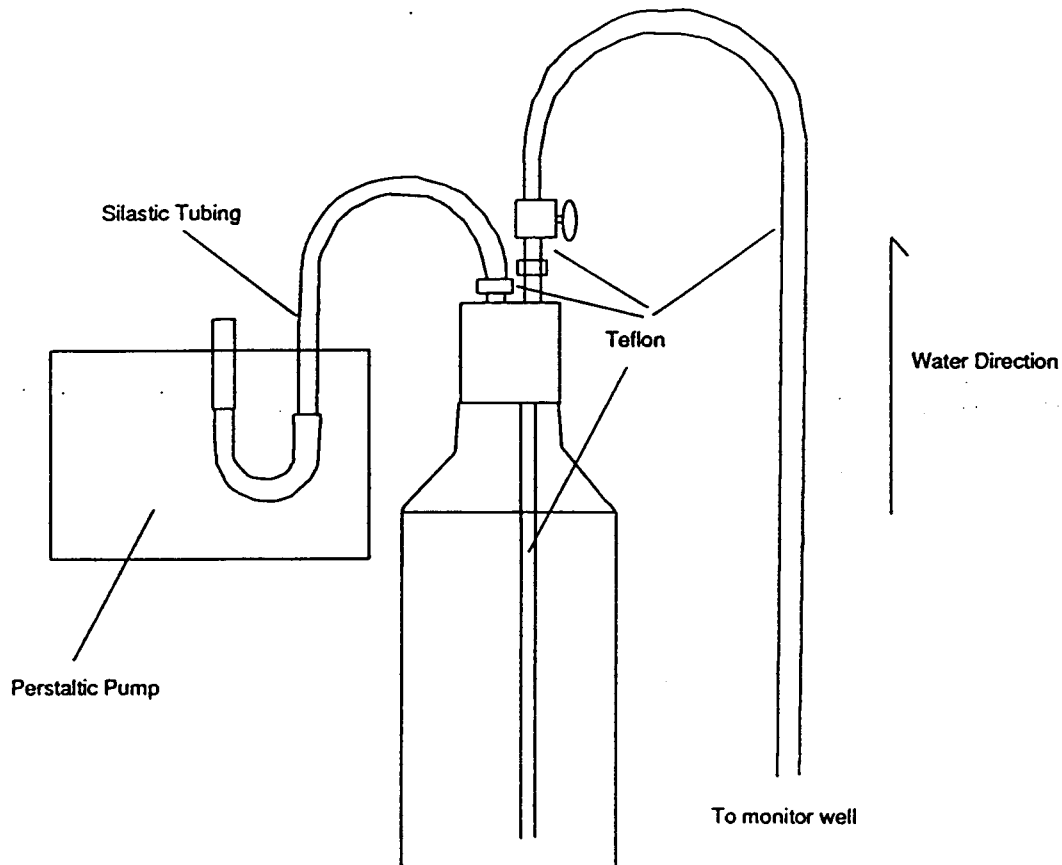
Field Data Form: During sample collection this form is filled out giving all the pertinent information about each well sampled. These forms are field out by the sampling crew. These are maintained in a bound waterproof logbook.

Labeling and ID: Samples are identified by placing a label on the bottles. The label provides the following information. Labels are filled out with a waterproof pen.

Field References: A GQAP and EPA SOP are kept in the field vehicles. Also, any pertinent PQAP is provided for the field personnel to review and have available before going to the site.

Figure 6.1

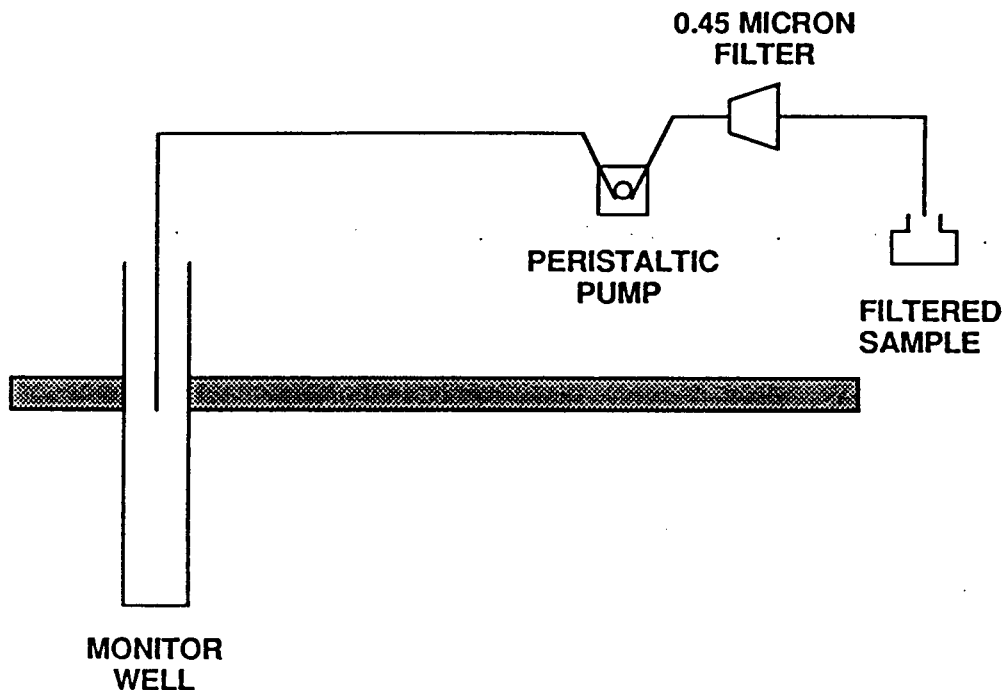
DIAGRAM OF SYSTEM FOR COLLECTING ORGANICS
THROUGH A PERISTALTIC PUMP



The sample container is a glass bottle threaded to use either a permanent teflon-lined cap or a sampling cap with teflon insert similar to the design above.

Figure 6.2

DIAGRAM OF RECOMMENDED FIELD FILTRATION SYSTEM FOR TRACE METALS



FIELD FILTRATION SCHEMATIC

1. Use one piece, molded, in-line high capacity disposable 0.45 micron filter.
2. Filter material should be non-contaminating synthetic fibers.
3. Filter should be placed on the positive pressure side of the peristaltic pump.
4. If well is deeper than 25 feet, a submersible pump may be necessary to bring the sample to the surface. Sample should be collected in a suitable container and filtered immediately, using the above system.
5. At least one filtered equipment blanks using deionized water must be collected and analyzed.

Figure 6.3

MONITORING WELL
SAMPLING FIELD DATA

SITE NAME (from permit) _____ SITE GMS # (from permit) _____

WELL "NAME" (from permit) _____ WELL TESTSITE # (from permit) _____

DOES WELL APPEAR TO BE DAMAGED IN ANY WAY? (circle one) YES / NO

IF YES, EXPLAIN _____

DISTANCE FROM TOP OF CASING TO TOP OF WATER (feet) (0.1 Precision) _____

DISTANCE FROM TOP OF CASING TO BOTTOM OF WELL (feet) _____

LENGTH OF WATER COLUMN (feet) _____ DIAMETER OF WELL CASING (inches) _____

VOLUME OF WATER COLUMN IN WELL (gallons) _____

PURGING DEVICE

PUMP

BAILER

OTHER

TYPE _____ BAILER VOLUME _____ (gallons) NARRATIVE DESCRIPTION
RATE _____ # OF BAILERS REMOVED _____ REQUIRED

*Three to five well volumes must be purged prior to sample collection.

PURGE DATE/TIME - START _____ / _____ END _____ / _____ VOLUME PURGED (gallons) _____

LOG OF FIELD MEASUREMENTS TAKEN PRIOR TO SAMPLE COLLECTION

* Field measurements must be stabilized over at least three consecutive readings.

TIME	_____	_____	_____	_____
VOLUME OF WATER REMOVED (gallons)	_____	_____	_____	_____
pH	_____	_____	_____	_____
TEMPERATURE (°C)	_____	_____	_____	_____
SPECIFIC CONDUCTIVITY (umhos/cm)	_____	_____	_____	_____
EH (Redox Potential) (millivolts)	_____	_____	_____	_____

SAMPLE DEVICE _____ COMPOSITION OF DEVICE _____

SAMPLE DATE _____ SAMPLE TIME _____

SAMPLE COLLECTED BY _____ of _____

LABORATORY ANALYSES BY _____

Figure 6.4

SPECIFIC CONDUCTIVITY
CALIBRATION FORM

Date: _____ Site ID: _____
Conductivity Meter: YSI Model No.: _____

CALIBRATION
(Before Sampling)

Time: _____ Technician: _____
Batteries Acceptable: Yes No
Red Line Adjust Acceptable: Yes No
Zero Adjust Acceptable: Yes No
Temperature Reading: _____
Calibration Value: _____
CAL Control Adjustment Acceptable: Yes No

CALIBRATION
(After Sampling)

Time: _____ Technician: _____
Batteries Acceptable: Yes No
Red Line Adjust Acceptable: Yes No
Zero Adjust Acceptable: Yes No
Temperature Reading: _____
Calibration Value: _____
CAL Control Adjustment Acceptable: Yes No

Figure 6.5

pH CALIBRATION FORM

Date: _____ Site ID: _____
pH Meter: _____ Model No: _____

CALIBRATION
(Before Sampling)

Time: _____ Technician: _____
pH buffer 7 reading: _____
pH buffer 4 or 10 reading: _____
Slope: _____

pH BUFFER MEASUREMENTS
(After Sampling)

Time: _____ Technician: _____
pH buffer 7 reading: _____
pH buffer 4 or 10 reading: _____


CALIBRATION
(After Sampling)

Time: _____ Technician: _____
pH buffer 7 reading: _____
pH buffer 4 or 10 reading: _____
Slope: _____


Slope < 90% may be caused by a defective pH electrode or a contaminated buffer solution.

Figure 6.6

Sample Label With Preservation Noted

 Analytical Technologies, Inc.	
PENSACOLA, FL (904) 474-1001	
SAMPLE SITE	SAMPLE TYPE
FIELD I.D.	DATE
ANALYSIS	TIME
	PRESERVATIVE
SPECIALTY CLEANED CONTAINER	

Sample Seal

 Analytical Technologies, Inc. 11 EAST OLIVE ROAD • PENSACOLA, FLORIDA 32514	SAMPLE NO.	DATE	SEAL BROKEN DATE SEAL PA 4401
	SIGNATURE		
	PRINTED SIGNATURE		

7.0 Sample Custody

In addition to proper sample collection, preservation, storage and handling; appropriate sample identification procedures and chain of custody are necessary to help ensure the validity of the data. The purpose of such procedure is to establish detailed legal documentation of all transactions in which the samples are transferred from the custody of one individual to another. The procedures are utilized from the point at which the sample containers leave the lab through collection all the way to the opening of the samples in the laboratory and includes the courier that handles the samples. All materials and equipment that come into contact with the sample becomes an integral part of the sample and must be documented. A sample is considered under custody if it is in your possession, in your view after being in your possession, or placed in a secure area after being in your possession. A special chain-of-custody form Figure 6.7, Section 6.0, page 28, contains all pertinent information for tracking samples from the field to the destination. The preservations will be written on the Chain of Custody at the time of collection. Samples will be preserved in accordance with Table 6.3 of Section 6.0.

7.1 Field Sample Operations

The field sampling operations responsibility to sample custody information include the documentation of the following: preservative, recording of equipment utilized in field and the calibration associated with that days sampling, recording of location that sample was taken and acquisition information, attaching labels to samples and filling out sample chain of custody forms as given in Figure 6.7, Section 6.0, page 28. All field records are maintained in bound logbooks which are numbered. Form AP1 is also filled out in the field (see Figure 6.3, Section 6.0, page 24).

7.1a Reagents for Preservation

All reagents for sample preservation are prepared by the supervisor of the inorganic laboratory. All reagents are obtained from Baxter Scientific and are ACS reagent grade chemicals. Each reagent is labeled by name, date prepared, date of expiration, date certified, and concentration. The lab manager submits the reagent for testing for each parameter that may be affected by that preservation reagent.

.Section No.: 7
.Revision No.: 8
.Date: July 28, 1990
.Page: 2 of 7

The results of each test and the preparation of each reagent is recorded in the sample reagent log book by the inorganic lab supervisor. The results are reviewed by the laboratory manager and QA Officer and certified by the signature of the laboratory manager on the reagent label and sample reagent book. An example of the sample reagent log sheet is given in Figure 7.1.

Figure 7.1
Sample Preservative Reagent Log Book

Reagent: _____

Concentration: _____

Date Prepared: _____

Date Expired: _____

Preparation Procedure:

Test Results:

Parameter/Method

Results

<u>Parameter/Method</u>	<u>Results</u>
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Certified Signature: _____

7.1b Sampling Equipment

All the sampling equipment must be checked by the field supervisor immediately before it leaves the laboratory. The check list should include:

- .All batteries charged
- .Back-up systems for equipment failure are working
- .Instruments have been calibrated.
- .Ensure that all clean bottles are available for all parameters for each sample.

Results of check list are recorded in the maintenance log book along with the date, time, and any corrective action if needed. Calibration data is recorded in field book as pertinent information for sampling. If any malfunction occurs in the field, the problem and the corrective action is described in the sample field book. If the malfunction can not be corrected in the field, the laboratory manager must be notified before sampling may continue.

7.1c Sample Labels

All sample containers will be affixed with a label which contains all pertinent information including sample identification number, sample location, date, time sampled, sample type, sampler's name, preservative utilized, and test required. All information will be recorded with water proof ink. Figure 6.6 demonstrates the sample label and sample seal respectively.

7.2 Laboratory Operations

The sample custodian is responsible for logging all samples into the laboratory and verifying all data entered onto the sample custody records. Upon sample receipt, the sample custodian will record all samples into the laboratory master log book and assign a laboratory log number to each sample. The laboratory log number is attached to each sample container along with a color sticker to help track the sample through the laboratory. Figure 7.2 is an example of a master log book.

The analytical test parameters are transferred from the chain of custody records and field book records to a laboratory work sheet. The laboratory work sheets are then reviewed by the laboratory manager to ensure all necessary tests are requested and that proper priority is assigned. The sample is then delivered by the sample custodian to a designated sample receiving area and the laboratory work sheets are delivered to each divisional laboratory supervisor from which analytical data are requested.

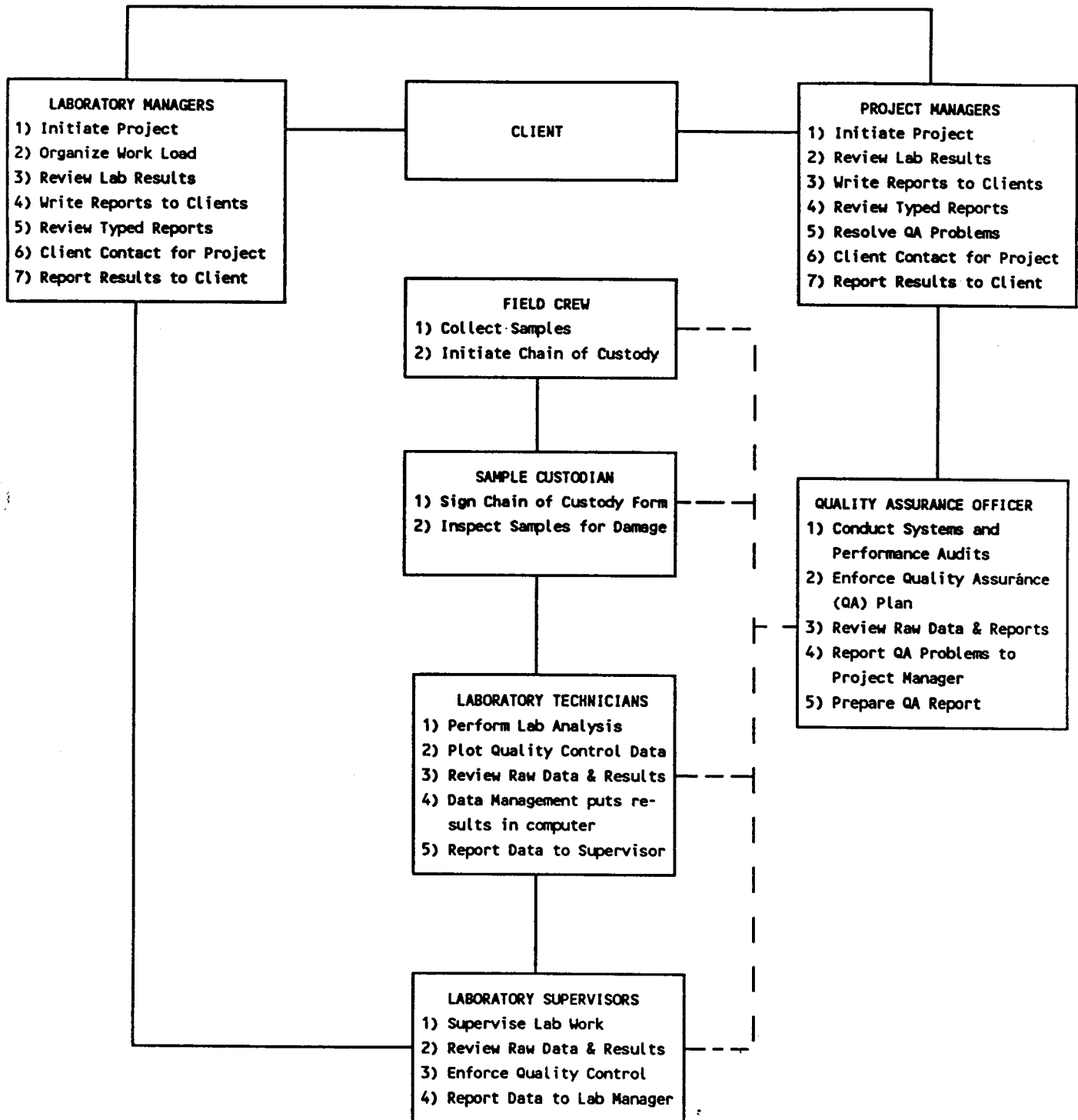
The laboratory supervisors are then responsible for obtaining their respective samples and organizing the work performed on each sample by filling out the Quality Control Tracking sheets for the organic parameters or the sample data form for the inorganic parameters. The laboratory analysts become responsible for tracking the sample through the laboratory by returning the samples, after removing the appropriate aliquot to color coded sample carts which have matching colors on the sample bottle.

Once the laboratory work sheet is completed by the analysts and reviewed by the respective laboratory supervisor, the remaining sample is placed in the proper storage facility by the supervisor and the completed work sheet is delivered to the laboratory manager. The laboratory manager then approves the data or requests additional information from the laboratory supervisors. When all data is satisfactory, the laboratory manager signs the work sheet and delivers the work sheet which also contains the quality control data, to the quality assurance officer who reviews the quality control data and signs with her approval before the final draft is sanctioned. Figure 7.3 outlines the data flow and reporting scheme.

Date	Lab ID	Type Sample	No. of Samples	No. of Bottles	Customer	Location	Analysis

GE_SG001163

Figure 7.3
 Data Flow and Reporting Scheme



Solid Line: Flow of Data and Reporting
 Dotted Line: Flow of QA Auditing

8.0 Calibration Procedures and Frequency

Table 8.1 gives the calibration frequency and standards used for laboratory instrumentation. Working standards are prepared daily from primary or stock standards. Stock standards are stored at 4°C (0°C for gases) for periods of time as specified in each method. Each workstation is equipped with standards preparation logbooks. Logbooks contain information such as: Lot numbers of neat or diluted compounds, date of preparation, date received, date opened, expiration date, initial weight/volume, final volume, solvent used, and analyst's initials. All standards are also traceable to the National Bureau of Standards.

The initial calibration procedure is performed when the method is originated. The initial calibration is prepared for volatiles, extractables and pesticides. The GC/MS work is based on responses at 5 different concentrations. The response factor defines the slope of the calibration curve. The initial response factor is determined by computing the mean response factor at the different concentration levels. The % RSD from the initial calibration curve must fall within the range specified in the method (or < 30%). The continuing calibration standard at midrange concentration is analyzed daily or every 12 hours to verify the initial calibration. If the % Difference of the continuing calibration standard falls out of the range specified in the method, a new initial calibration is prepared (SW-846 methods < 15%; CLP < 25%).

Calibration curves are run daily or with each series of tests for all other analyses (TOC, PAH's, TPH, Metals, Inorganics, etc.). Calibration curves are prepared to represent the linear range of the instrument and will bracket the range of samples. Correlation coefficients are calculated to determine linearity of the curve. The curve is verified every 20 samples with one standard to $\pm 10\%$.

All standards are checked at least quarterly by an outside source or QC Standard.

Table 8.1
Standard Calibration

Laboratory Instrument	Frequency	#of STD	Type Standard	Standard	Source
Infrared					
-Perkin Elmer 1320	Daily	5	E	Oils (TPH)	Baxter
Ultra Violet-Visible					
-Bausch and Lomb 601	EST	3	E	CN, SO ₄ , Phenols Chromium Hex	Baxter
Atomic Absorption					
-Perkin Elmer 5100/HGA Zeeman 600 Graphite Flame FIAS 200	EST	3	E	Mercury	Plasma & SPEX STDs
-Perkin Elmer 5100 with HGA Zeeman 600	EST	3	E	Metal Concentrates	Plasma & SPEX STDs
Atomic Emission					
-Inductively Coupled Plasma/6500XR AS50	EST	3	E	Metal Concentrates	Plasma & SPEX STDs
Flashpoint Detector					
-Pensky-Martens APM-5	Daily	N/A	N/A	SW-846, 1010	N/A
ICP					
-Thermojarrell-Ash 61E with TJA 300 Sample changer	EST	3	E	Metal Concentrates	Plasma & SPEX STDs
Total Org. Carbon Analyzer					
-Dorhmann	Daily	1	E	Anhydrous K bi- phthalate	Baker
Total Org. Halide Analyzer					
-Dorhman Model DX20	EST	N/A	E	2,4,6-Trichloro- phenol	Fisher Scientific
Finnegan (GC/MS)					
-2 - Incos 50 (Volatiles) Interface/HP GC-5890	Every 12 hrs	5	I	Volatiles Method 624, 8240	ACCU Standard
Tekmar P&T (ALS)	Every 12 hrs	1		BFB Tune Perform- ance check	ACCU Standard
Tekmar LSC2					
-Incos 50 (Semivolatiles) Interfaced with	Every 12 hrs	5	I	Method 625, 8270 Semivolatiles	ACCU Standard
HP GC-5890 & 7673A Auto Sampler	Every 12 hrs	1		DFTPP-Tune Perfor- mance check	ACCU Standard

Table 8.1 (cont'd)

Laboratory Instrument	Frequency	#of STD	Type Standard	Standard	Source
Gas Chromatographs					
-HP5890 w/ECD Detectors, DB-608/DB-5 columns, and HP7673A autosamplers (2)	Daily	3/5	E	Pests 608/8080, PCB Herbs 615, EDB 504	ACCU Standard
-HP5890 Series II w/Dual FID Detectors and HP7673A autosampler (1)	Every 12 hrs	5	I	TPH and Herbs 8015	ACCU Standard
-HP5890 Series II w/OI PID Detector, OI ELCD Detect- or, OI 4460A P&T, and OI autosampling module (1)	Every 12 hrs	5	I	EPA Method 502.2 Purgeables and Vol- atiles	ACCU Standard
-HP5890 Series II w/Tekmar LSC 2000, Tekmar ALS 2016, and OI Detector FID/PID (1)	Every 12 hrs	5	I	BETX and TPH (5030/8020/8015)	ACCU Standard
-HP5890 w/3 ELCD, 3 PID Detectors, Tekmar ALS 2016 16 position autosampler, and LSC 2000 P&T (3)	Every 12 hrs	3/5	I	601/602 and 8010/ 8020. Purgeables Volatiles	ACCU Standard
-Tracor 540 GC w/ Tekmar ALS (10 position autosampler, LSC2 P&T and Tracor Detect- ors (5 Hall & 5 PID) (5)	Every 12 hrs	3/5	I	601/602 and 8010/ 8020. Purgeables Volatiles	ACCU Standard
High Performance Liquid Chromatography					
-Hitachi HPLC with post column reactor & 2000 AS Autosampler & L6200 Pump, L4000 UV Detector , F1000 Fluorescence Detector	Daily	3	E	Carbamates, EPA 531 632 methods	ACCU standard
-Hitachi 655A,L3000,L6200	Daily	3/5	E	610's and 8310's	ACCU Standard

Table 8.1 (cont'd)

Laboratory Instrument	Frequency	#of STD	Type Standard	Standard	Source
Meters					
-pH meter Corning 150	Daily	2	E	Buff soln (7&4,7&10)	Fisher Scientific
Orion SA520	Daily	2	E	Buff soln (7&4,7&10)	Fisher Scientific
Orion 901 ion analyzer	Daily	3/5	E	Fluoride	Mallinkrodt
-Conductivity YSI Model 35	Daily	2	E	KCl solution	Baker
-Dissolved Oxygen Meters	Hourly	1	E	DI Water	Millipore
Model 50	Daily	5	E	N/A	N/A
-Yellow springs instruments					
Model 57	Daily				
Incubators					
-Fisher Isotemp (fecal coli- form, 45°C)	Daily	N/A	N/A	N/A	N/A
-Blue M Stabil-Therm (total coliform, 35°C)	Daily	N/A	N/A	N/A	N/A
-Lab-Line Instrument (800, 20°C)	Daily	N/A	N/A	N/A	N/A
Ovens					
-Blue M Model (TSS, 105°C)	Daily	N/A	N/A	N/A	N/A
-Thelco Model 17 (TDS,180°C)	Daily	N/A	N/A	N/A	N/A
-Blue M-Glassware	Weekly	N/A	N/A	N/A	N/A
-Modern Laboratory Equipment					
Glassware	Weekly	N/A	N/A	N/A	N/A
-Despatch-Glassware	Weekly	N/A	N/A	N/A	N/A
Muffle Furnace					
-Thermolyne 1500					
(Volatile solids, 600°C)	Quarterly	N/A	N/A	N/A	N/A
-Thermolyne Dubuque III	Quarterly	N/A	N/A	N/A	N/A
Steam Bath					
-Precision Scientific	N/A	N/A	N/A	N/A	N/A
Thermometers					
-Ertco-NBS certified	Annually	N/A	N/A	NBS ID #88024	ERTCO
Refrigerators					
-Admiral	Daily	N/A	N/A	N/A	N/A
-Kenmore (3)	Daily	N/A	N/A	N/A	N/A
-Precision Scientific	Daily	N/A	N/A	N/A	N/A
-Starret-Cold Chest	Daily	N/A	N/A	N/A	N/A

Table 8.1 (cont'd)

Laboratory Instrument	Frequency	#of STD	Type Standard	Standard	Source
Alpkem 305A -Rapid Flow Analyzer	EST	3/5	E	Potassium Dihydro- Ammonium Sulfate & Potassium Nitrate	Baxter
Balances					
-Analytical Balance 4 deci- mal places		1/2		Class "S" Weights	
*Mettler-Model H10 (2) (by weight check)	Daily Yearly				
*Mettler-Model AE 100 (by weight check)	Daily Yearly				
-Top Loading Balance 2 deci- mal places					
*American Scientific Prod- ucts TL410	Weekly Yearly				
(by weight check)					
*Ohaus-B 15000	Weekly Yearly				
(by weight check)					
Turbidimeter					
-Orbeco-Hellige	EST	4	E	Turbidity Suspension	Baker

Note:

- (1) EST = Each series of test
- (2) Series = Maximum of 20 samples

Type Standard

- E = External Standard
- I = Internal Standard

9.0 Analytical Procedures

All analytical procedures used to evaluate water or sludge, which is regulated by a governmental agency, are approved methods by Environmental Protection Agency (EPA) and Florida Department of Environmental Regulations (FDER). Table 5.1 summarizes all the approved methods and their references.

9.1 Laboratory Glassware

The exact cleaning techniques chosen will depend on determinations to be performed as well as substances to be removed. The following procedures have been found to be simple and effective.

Immediately after use, all glassware should be immersed in a solution of Alconox or Liquinox. Scrubbing with a brush followed by tap water rinse, acid rinse, then distilled water rinse is adequate for general glassware use. The following cleaning procedures are used for special parameters.

9.1a Organic Parameters

Where the presence of trace concentrations of organic matter may present a problem (e.g., BOD, COD, pesticides), chromic acid cleaning solution is recommended. Add sufficient water to 65 grams of finely ground potassium dichromate to make a paste. Slowly, add 1 liter of concentrated sulfuric acid. Store in a tightly sealed borosilicate glass container.

Either immerse the glassware in the chromic acid solution or fill the glassware and allow to stand for 15-20 minutes. Chromic acid can be used repeatedly until it begins to turn green.

After soaking, rinse the glassware extremely well with warm tap water and then purified water. Glassware to be used in the BOD test must be free of chromatic. Glassware to be used in pesticide analyses should be rinsed with pesticide grade acetone.

9.1b Trace Metal Parameters

Aqua regia (3 parts concentrated HCl to 1 part concentrated nitric acid) diluted 50-50 with de-ionized water is an excellent solvent for trace metals. Soak glassware for one hour, rinse well with warm tap water and de-ionized water. Glassware to be

used for mercury determinations at the part-per-billion level require special precautions. Before first use, soak this glassware in chromic acid solution, rinse well with tap water and then soak in the dilute aqua regia bath. Rinse well with warm tap water and de-ionized water. Keep this glassware separate from all other glassware after cleaning. Subsequent uses should require only the dilute aqua regia cleaning.

9.1c Nutrient Parameters

Glassware for use in the analysis of nitrogen or phosphorus parameters should only be washed with 1:1 hydrochloric acid. Detergents should never be used. Rinse the glassware with warm tap water and purified water. This glassware should always be kept separate.

9.1d Pipettes

All pipettes are disposable.

10.0 Data Reduction, Validation, and Reporting

Equations used to calculate the concentration for each test parameter are presented in their respective methods referenced in Table 5.1. The basic calculations all involve calibration factors which relate a known concentration to an instrumental, chemical, or physical measurement. The reporting units are based on the respective calibrations which are defined in each analytical method. Table 10.1 shows the calculations and equations for the major parameter groups. All raw data and final results are recorded by the analysts on specific data forms or computerized reports directly from the instrument. These forms are reviewed by the respective supervisors and then filed in numerical order according to test parameters.

The final results are recorded by the supervisor on the laboratory work sheet and submitted to the laboratory manager for their approval. Figure 7.3, Section 7.0, page 7, describes the data flow and reporting scheme. The enforcement of the entire Quality Control program described in this document is the criteria used to validate data from collection to reporting. This criteria includes chain of custody procedures, analysis of blanks, duplicates, check samples and spikes, monitoring of recoveries and RPD's, and internal and external audits. There are numerous factors that influence data and each must be constantly monitored to ensure valid results.

Some of the data which must be constantly monitored as to ensure valid data are:

1. Sample preparation and treatment
2. Analytical operations
3. Calibration procedures
4. Instrumental conditions and adjustments
5. Data handling
 - a. calculations, corrections, adjustments to standard conditions, computer programs
 - b. statistical procedures used to report data
 - c. checks for internal consistency

Table 10.1

Calculations and Equations

ANALYTICAL GROUP

EQUATIONS

SEMIVOLATILE

$$\text{Relative Response Factor (RRF)} = \frac{(A_s) (C_{is})}{(A_{is}) (C_s)}$$

Where:

A_s = Area of compound
 C_{is} = Concentration of internal standard
 A_{is} = Area of the internal standard
 C_s = Concentration of standard

Water

$$\text{Concentration ug/L} = \frac{(A_x) (I_s) (V_t)}{(A_{is}) (RRF) (V_o) (V_i)}$$

Where:

A_x = Area of the characteristic ion for the compound to be measured
 A_{is} = Same as given above
 I_s = Amount of internal standard injected in nanograms (ng)
 V_o = Volume of water extracted in milliliters (ml)
 V_i = Volume of extract injected (μ l)
 V_t = Volume of total extract

Soil/Sediment

$$\text{Concentration ug/kg} = \frac{(A_x) (I_s) (V_t)}{(A_{is}) (RRF) (V_i) (W_s) (D)}$$

Where:

A_x, I_s, A_{is} = same as given for water (above)
 V_t = Volume of low level total extract (use 1000 μ L or a factor of this when dilutions are made. If GPC cleanup is used, the volume is 2000 μ L. The 1000 μ L is derived from concentrating the 9.5 mL extract to 0.95 mL.)

- or -

V_t = Volume of medium level total extract (use 2000 μ L or a factor of this when dilutions are made. If GPC cleanup is used, the volume is 2000 μ L. The 2000 μ L is derived from concentrating the 5 mL extract to 10 mL extract to 1 mL.)

V_i = Volume of extract injected (μ L)
 100 - % moisture

D = -----

100

W_s = Weight of sample extracted (grams)

Table 10.1 (Continued)
 Calculations and Equations

VOLATILE GC & GC/MS

$$\text{Relative Response Factor (RRF)} = \frac{(A_S) (C_{IS})}{(A_{IS}) (C_S)}$$

Where:

A_S = Area of compound
 C_{IS} = Concentration of internal standard
 A_{IS} = Area of the characteristic ion for the specific internal standard
 C_S = Concentration of standard

Water

$$\text{Concentration ug/L} = \frac{(A_X) (I_S)}{(A_{IS}) (RRF) (V_O)}$$

Soil/Sediment (medium level)

$$\text{Concentration ug/kg} = \frac{(A_X) (I_S) (V_t)}{(A_{IS}) (RRF) (V_i) (W_S) (D)}$$

Soil/Sediment (low level)

$$\text{Concentration ug/kg (Dry weight basis)} = \frac{(A_X) (I_S)}{(A_{IS}) (RRF) (W_S) (D)}$$

Where:

A_X = Area of the characteristic ion for the compound to be measured
 I_S = Amount of internal standard added in nanograms (ng)
 V_O = Volume of water purged in milliliters (ml) (take into account any dilutions)
 V_i = Volume of extract added (μ l) for purging
 V_t = Volume of total extract (μ L) (use 10000 μ L or a factor of this when dilutions are made)
 W_S = Weight of sample extracted (g) or purged
 100 - % moisture
 $D = \frac{\quad}{100}$

$$\text{Surrogate Recovery} = \frac{Q_d}{Q_a} \times 100$$

Where:

Q_d = Quantity determined by analysis
 Q_a = Quantity added to sample

Table 10.1 (continued)
 Calculations and Equations

=====

PESTICIDES, PCB's AND
OTHER GC PARAMETERS

EQUATIONS

$$\text{Relative Response Factor (RRF)} = \frac{\mu\text{g of analyte}}{\text{peak height}}$$

Water

$$\text{Concentration ug/L} = \text{RRF} \times \text{peak height (of sample)} \times \frac{\left[\frac{\text{Volume extracted in } \mu\text{l}}{\text{injection volume in } \mu\text{l}} \right]}{\text{liters extracted}}$$

Soil/Sediment

$$\text{Concentration ug/kg} = \text{RRF} \times \text{peak height (of sample)} \times \frac{\left[\frac{\text{Volume extracted in } \mu\text{l}}{\text{injection volume in } \mu\text{l}} \right]}{(\text{kg extracted}) (\% \text{ solids} \times .01)}$$

=====

METALS

EQUATIONS

Calibration curve Construction = $y = mx + b$

Calculation of water sample concentration (mg/L)

$$x = \frac{y-b}{m} \times \text{dilution factor}$$

Sediment - Conversion of mg/l to mg/kg ($\mu\text{g/g}$)

$$\mu\text{g/ml} \times \text{dilution factor} \times \frac{\text{final volume (milliliters) of digest}}{(\text{g of sample}) (\% \text{ solids} \times .01)}$$

Where: y = absorbance
 x = concentration (mg/l) m = slope $\frac{\text{absorbance}}{\text{concentration}}$
 b = y intercept

Table 10.1 (Continued)
Calculations and Equations

=====

NUTRIENTS AND
OTHER COLORIMETRIC
PROCEDURES

EQUATION

Water

$$\text{Concentration (mg/l)} = \text{mg/l}^* \times \text{dilution factor}$$

Sediment

$$\text{Concentration (mg/kg)} = \text{ug/ml}^* \times \frac{\text{milliliters of leachate (or digest)}}{(\text{g of sample}) (\% \text{ solids} \times .01)}$$

* - Concentration of sample from standard curve.

11.0 Field and Laboratory Control Checks

The controls used to maintain a check on the quality of both field and laboratory practices are:

11.1 Method Blanks

Method blanks also known as reagent blanks or equipment blanks are used to check laboratory contamination. Method blanks are analyzed each day or every 12-hour shift. An aliquot, equal in volume or weight to the samples, of laboratory deionized distilled water is used for method blank analyses. The method blank is subjected to the complete analytical process as though it were another sample. The blank should be free of any parameters being tested or interferences.

11.2 Method Standards or Quality Control Check Samples

Method standards are deionized distilled water which has been spiked with known concentrations of the parameters being tested. They are used to check the complete analytical system under optimum conditions excluding any chemical from sample matrix. The method standards are prepared at concentrations corresponding to the mid ranges for each parameter as defined in the calibration procedure of the respective analytical method. The quality control check samples are analyzed at a frequency of 10%.

11.3 Spiked Samples

Spiked samples are samples which have specific concentrations of various parameters of interest added, and are used to measure the performance of the complete analytical system including any chemical interference from sample matrix. ATI also uses the spike sample as the duplicate to reduce the number of analysis without reducing the amount of quality control. A minimum of a sample spike, a duplicate sample spike, and a quality control check sample are analyzed with each set at a frequency of ten percent (10%). Duplicate spike samples are prepared by first removing one aliquot of sample for a complete analysis and then spiking the remaining sample with the spiking standard. The spike concentration should correspond to the mid range of the parameter concentration defined in the calibration procedure of the respective analytical method. The spiked sample is then divided into two aliquots and one analyzed with each set of nine samples.

Water samples are thoroughly mixed by shaking the sample container before measuring out sample aliquots, and soil samples are mixed with a glass rod in a sample or a stainless steel mixing bowl before removing aliquots, with the exception of volatiles.

The value of the sample before spiking is determined from the first aliquot and the value of the spiked sample is determined on the remaining aliquots. Should the sample have a value for the spiked parameter, the value of the sample is subtracted from the value of the spike and the percent recovery of the spike is calculated using the following equation:

$$\% \text{ recovery} = \frac{(\text{spiked sample result} - \text{sample result}) \times 100}{\text{spike added}}$$

Duplication of the spiked sample is used for evaluating the laboratory precision. Occasionally, the sample and the spike sample will require dilution to perform analysis of a particular sample within the linear range of the instrument. This dilution will adjust the analyte to an acceptable range, but may dilute the spike below a detectable level, in which case the spike recovery can not be calculated.

11.4 Split Samples

Samples that require analysis by an outside laboratory are collected in the field by aliquoting a homogeneous sample into separate containers. The containers are then labeled as split samples and delivered with the proper chain-of-custody to the specific laboratories.

11.5 Blanks

Equipment (rinsate) Blank. The equipment (rinsate) blank is designed to address cross contamination in the field between sample sources due to deficient field cleaning procedures. This blank also addresses field preservation procedures, environmental site interference, integrity of the source blank water for field cleaning and those concerns singularly addressed by the travel blank.

An equipment (rinsate) blank will be prepared for each parameter group sampled where a particular piece of sampling equipment was employed for sample collection and subsequently decontaminated in the field for use in additional sampling. The equipment blank will be composed in the field by collecting, in the appropriate container for

the parameter group, a blank water rinse from the equipment (bailer, pump tubing, spoon, auger, corer, etc.) after execution of the last step of the proper field decontamination protocol. Preservatives or additives must be added to the equipment blank where appropriate for the parameter group. At least one equipment blank must be submitted for each piece of equipment used in the sampling process and cleaned in the field. If a piece of equipment is cleaned more than 20 times in one sampling event, the equipment blanks must be submitted at a frequency of 5% per equipment type.

Field Blank. Field blanks are used to evaluate the sample container filling procedure, the effects of environmental contaminants at the site, purity of preservatives or additives and those concerns uniquely addressed by the travel blank.

Field blanks are composed in the field, on-site, by filling sample containers (appropriate for the parameter group) using fresh source blank water. Preservatives or additives are added if necessary, and the blank sample container is then sealed. The field blank is then grouped/transported/stored/ with the real samples collected for the same parameter group. **Frequency:** One field blank per parameter group per day or at a frequency of 5% of the samples in the parameter group per day, whichever is greater.

Travel (Trip) Blanks. The travel blank is designed to address interferences derived from improper sample container cleaning preparation, contaminated source blank water, sample cross contamination during storage/transport, and extraneous environmental conditions affecting the sampling event to and from the site, including delivery to the analyzing laboratory.

Travel blanks are composed in the appropriate sample container using source blank water. Preservatives or additives are added if required for that parameter group. Travel blanks are then sealed and stored in the ice chest where real samples will be stored and transported. Travel blanks are to originate at the facility providing the blank water for the equipment and field blanks. **Frequency:** One trip blank for each volatile organic method (601, 602, 624, etc.) shall be provided per cooler used for storing and transporting volatile sample vials. If a laboratory require submission of multiple vials for a method, the same number of vials must be submitted for the trip blank.

Duplicate Samples. Duplicates are collected and analyzed at a frequency of at least one per sampling event or 10% of the samples (whichever is greater) for all parameters and matrices.

11.6 Surrogate Spike Samples

Where applicable, the analytical process includes the addition, subsequent detection, and recovery calculations, of surrogate spiking compounds.

Surrogate compounds are analyte compound substitutes which are chemically similar to the analytes in question, and emulate their respective instrumental response. Surrogate compounds are added to samples for analysis after sample aliquots have been measured and are subjected to the complete sample preparation and analytical processes. Surrogate compounds are used to monitor the analytical process and must be free from interferences. Only the gas chromatographic methods utilizing mass spectrometer detectors require surrogate spikes.

11.7 Calibration Standards

Internal standards, spiking standards and surrogate standards are discussed in "ATI's Standard Operation Procedure" for the preparation of standards. Table 11.1 lists the surrogate compounds and accuracy limits for EPA methods.

Table 11.1
 Surrogate compounds and accuracy limits for EPA Methods.

WATER

<u>Surrogate</u>	<u>EPA Method</u>	<u>% Recovery</u>
1,2-Dichloroethane-D-4	624, 8240	76 - 114
Toluene-d8	624, 8240	88 - 110
Bromofluorobenzene	624, 8240	86 - 115
Nitrobenzene-d5	625, 8270	35 - 114
2-Fluorobiphenyl	625, 8270	43 - 116
Terphenyl-d14	625, 8270	33 - 141
Phenol-d6	625, 8270	10 - 94
2-Fluorophenol	625, 8270	21 - 100
2,4,6-Tribromophenol	625, 8270	10 - 123

SOIL

<u>Surrogate</u>	<u>EPA Method</u>	<u>% Recovery</u>
1,2-Dichloroethane-D-4	8240	70 - 121
Toluene-d8	8240	81 - 117
Bromofluorobenzene	8240	74 - 121
Nitrobenzene-d5	8270	23 - 120
2-Fluorobiphenyl	8270	30 - 115
Terphenyl-d14	8270	18 - 137
Phenol-d6	8270	24 - 113
2-Fluorophenol	8270	25 - 121
2,4,6-Tribromophenol	8270	19 - 122

12.0 Performance and Systems Audit

12.1 Internal

The QA Officer will conduct Performance and Systems Audits on a semiannual basis.

12.1a Systems Audit

The Systems Audit will consist of an inspection of the following procedures:

1. Sampling;
2. Sample Custody;
3. Sample Storage and Preservation;
4. Sample Preparation;
5. Analytical Methodology;
6. Data Management;
7. Preventative Maintenance; and
8. Archiving Data.

During the systems audit each laboratory technician will be audited for compliance with the Quality Assurance/Quality Control (QA/QC) plan. The items evaluated include QC data, conformance to standard operation procedures, calibration and record-keeping.

The laboratory and field activities are subject to these audits which will serve to verify compliance and performance, and to identify deficiencies when they exist. If any deficiencies are encountered, they are classified as undesirable but not critical or as critical and requiring immediate action. The QA Officer will keep a log of problems encountered and corrective actions taken. There should be no carry over from audit to audit.

The QA Officer will use the checklists in Figure 12.1 to assist in the systems audits.

12.1b Internal Performance Audit

The internal performance audit consists essentially of evaluating the accuracy of all data.

A performance audit will consist of introducing blind performance evaluation samples to the laboratory from Environmental Protection Agency (EPA) and Environmental Resource Associates (ERA). ATI participates in ERA's laboratory QA program on a quarterly basis for Waste Watr*, PCB's in oil, Priority Pollutnt*, and Potable Watr* QA samples.

12.2 External Audit

ATI routinely participates in systems and performance audits by regulatory agencies.

12.2a Regulatory Agencies

The State of Florida Department of Health and Rehabilitative Services (DHRS) conducts interlaboratory audits on an annual basis for the certification of drinking water and wastewater analyses. The laboratory is certified for drinking water analysis by Florida DHRS according to the regulations set forth under the Florida Safe Drinking Water Act and is an approved laboratory for environmental water by FDER.

Any work performed for DER may be subject to on-site audits conducted by the DER QA section.

ATI holds certifications in the states of Alabama, North Carolina, South Carolina, Wisconsin, Virginia and Tennessee. On-site audits are conducted once every 3 years by the states of North Carolina, South Carolina, and Wisconsin.

All external audits are conducted to ascertain compliance with rules, regulations, or criteria for certification. A report will be submitted to the laboratory following the audit and will list any deficiencies found during the audit. The laboratory is required to take corrective actions and correct problems immediately.

Note: * = Trade Mark

12.2b Performance Evaluations

ATI participates in the following performance evaluation programs:

- 1) EPA, Environmental Monitoring and Support Laboratory - Cincinnati
- 2) National Institute for Occupational Safety and Health
- 3) State of North Carolina, Division of Environmental Management

The major parameter groups analyzed are:

Trace Metals
Minerals
Nutrients
Demands
Insecticides
Herbicides
PCB's
Volatile Halocarbons
Volatile Aromatics
Trihalomethanes
Miscellaneous Analytes

The frequency of these performance evaluation samples is as follows:

<u>Performance Evaluation Program</u>	<u>Samples Issued</u>
EPA Water Supply	Semiannual
EPA Water Pollution	Semiannual
North Carolina	Annually
NIOSH	Quarterly

Figure 12.1

QUALITY ASSURANCE REPORT
 QUARTERLY GENERAL AUDIT

Date: _____

Auditor: _____

A. SYTEMS AUDIT SUMMARY

PROCEDURES AUDITED	ACCEPTABLE		COMMENTS
	YES	NO*	
I. Sampling			
II. Sample Custody			
III. Sample Storage & Preservation			
IV. Sample Preparation			
V. Analytical Methodology			
VI. Data Management			
VII. Preventative Maintenance			
VIII. Archiving Data			

B. PERFORMANCE AUDIT SUMMARY

PARAMETER	ACCEPTABLE		COMMENTS
	YES	NO*	
Alkalinity			
Demand			
Chloride			
Chlorine			
Conductivity			
Cyanide			
Fluoride			
Hardness			
Nutrients			
Oil & Grease			GE_SG001185

B. PERFORMANCE AUDIT SUMMARY (continued)

PARAMETER	ACCEPTABLE		COMMENTS
	YES	NO*	
Phenols (4AAP Method)			
Sulfate			
Suspended Solids			
Turbidity			
Metals			
Herbicides			
Pesticides			
Volatile Organics (GC)			
Volatile Organics (GC/MS)			
Semi-Volatiles (GC/MS)			
PAH's			

* If NO was checked, a corrective action report must be included with this report.

I. SAMPLING QA AUDIT CHECKLIST

Date: _____ Auditor: _____

Sampler: _____ Site Identification: _____

Project Name: _____ Sample Numbers: _____

QAP (circle one): Project Specific Generic

GENERAL ITEMS	YES	NO*
1. Does the sampler understand the sampling procedures in the QAP?		
2. Are the field notes recorded in indelible ink?		
3. Are the field notes bound and/or recorded on standard forms?		
4. Were cross-out procedures followed?		
5. Were insitu instruments calibrated at the beginning and end of the day?		
6. Was the correct decontamination procedure followed?		
7. Were new gloves worn to collect samples?		
8. Were the proper containers used to collect samples?		
9. Were the samples preserved correctly?		
10. Were volatile samples collected properly?		
11. If volatiles were collected, was a trip blank present?		
12. Were the least contaminated sites collected first?		
13. Were the samples labeled correctly?		
14. Were chain of custody forms completed correctly?		
15. Were the required number of field blanks collected?		
16. Were the required number of field duplicates collected?		
17. Were the samples stored and shipped properly?		

II. SAMPLE CUSTODY QA AUDIT CHECKLIST

Date: _____

Auditor: _____

Sample Custodian (Laboratory Clerk): _____

SAMPLE RECEIPT AND LOGGING	YES	NO*
1. Is there a written SOP near the working area?		
2. Did a chain of custody record accompany the shipment?		
3. Were all chain of custody forms signed and dated?		
4. If shipment was mailed, was the shipment sealed?		
5. Were the samples received cold?		
6. Are the sample containers intact?		
7. Were volatile samples received with no headspace?		
8. Do the sample tags, containers and custody forms agree?		
9. Did the custodian record samples into the Lab Master Logbook?		
10. Did the custodian assign a sample number to each sample?		
11. Were samples, collection date and time, and parameters entered into the computer correctly?		
12. Were samples placed in receiving area with custody form?		
13. Did the custodian properly relinquish samples?		
14. Were all entries recorded in indelible ink?		
15. Was the cross-out procedure followed?		
16. If corrective action was required, did the custodian fill out a corrective action report?		

* If NO was checked, a corrective action report must be generated.

N/A = Not Applicable

Comments:

III. SAMPLE STORAGE AND PRESERVATION QA AUDIT CHECKLIST

Date: _____

Auditor: _____

Sample Custodian: _____

SAMPLE STORAGE AND PRESERVATION	YES	NO*
1. Were chain of custody forms properly relinquished by the sample custodian?		
2. Are the samples stored in a secure area?		
3. Are samples logged into storage?		
4. Are samples logged out of storage?		
5. Was a written explanation provided for removing samples?		
6. Are samples preserved correctly?		
7. Are temperature logsheets maintained?		
8. Are thermometers calibrated once per month?		
9. Does anyone besides the custodian have access to the sample storage area? NAME: _____		
10. If Item 9 was checked YES, were proper chain of custody procedures followed?		
11. Were all entries recorded in indelible ink?		
12. Was the cross-out procedure followed?		
13. If corrective action was required, did the custodian fill out a corrective action report?		

* If NO was checked, a corrective action report must be generated excluding Item 9.

N/A = Not Applicable

Comments:

IV. SAMPLE PREPARATION QA AUDIT CHECKLIST

Date: _____
 Auditor: _____
 Digester/Extractor: _____

SAMPLE PREPARATION	YES	NO*
1. Is the preparation area suitable for sample preparation (i.e. clean, organized, and sufficient hood space?)		
2. Is there a written SOP near the working area?		
3. Does the digester work under the hood when handling toxic and volatile materials?		
4. Is the air flow on the hoods checked and recorded monthly?		
5. Are all samples and containers properly labeled?		
6. Does the digester follow the SOP provided?		
7. Are solvents, acids and bases properly stored?		
8. Are solvent storage cabinets properly vented?		
9. Are fresh standards prepared at the required frequency?		
10. Are reagent grade chemicals used to prepare standards?		
11. Are QC samples spiked correctly?		
12. Are the required number of QC samples prepared?		
13. Are digestion/extraction logbooks maintained?		
14. Are sample extracts stored separately from standards?		
15. Are all entries recorded in indelible ink?		
16. Was the proper cross-out procedure followed?		
17. If corrective action was required, did the digester fill out a corrective action report?		

* If NO was checked, a corrective action report must be generated
 N/A = Not Applicable
 Comments:

V. ANALYTICAL METHODOLOGY CHECKLIST

Date: _____
 Auditor: _____
 Technician/Duties: _____
 Analytical Procedure Audited: _____ EPA Method _____

ITEM	YES	NO*
1. Is there a written SOP near the working area?		
2. Does the analyst follow the SOP provided?		
3. Are the required number of calibration standards analyzed?		
4. Was a valid detection limit reported?		
5. Was the correlation coefficient ≥ 0.995 ?		
6. Was a QC sample of known concentration analyzed?		
7. Were the required number of method blanks analyzed?		
8. Were the required number of spikes and duplicates analyzed?		
9. Was the accuracy acceptable or corrective action taken?		
10. Was the precision acceptable or corrective action taken?		
11. Were the precision and accuracy results plotted?		
12. Were all adverse trends and out of control situations documented on a corrective action form?		
13. Was a continuing calibration standard analyzed?		
14. Were all entries recorded in indelible ink?		
15. Was the cross-out procedure followed?		
16. Were raw data (strip charts, chromatograms and computer printouts) labeled with date, time, sample ID and initials?		
17. Are all analysis forms correctly completed?		
18. Do sample responses bracket the calibration curve?		
19. Was a 1 point calibration performed (ICAP only)?		

V. ANALYTICAL METHODOLOGY CHECKLIST (continued)

ITEM	YES	NO*
20. Was the linear range verified quarterly (ICAP only)?		
21. Was a multielement interference check sample analyzed beginning, every 20 samples and end of run (ICAP only)?		
22. Are wavelengths documented for each analysis (metals only)?		
23. Was the instrument tuned every 12 hours (GC/MS only)?		
24. Were the surrogate compounds spiked into all samples and standards (GC and GC/MS)?		
25. Was an internal standard spiked into all samples and standards? (GC only)?		
26. Are oven temperatures recorded daily?		
27. Are refrigerator temperatures recorded daily?		
28. Is the quality of the de-ionized water checked daily?		
29. Is the de-ionized water system checked daily?		
30. If corrective action is required, did the technician fill out a corrective action report?		

* If NO was checked, a corrective action must be generated.

N/A = Not Applicable

COMMENTS:

VI. DATA MANAGEMENT QA AUDIT CHECKLIST

Date: _____

Auditor: _____

Sample Numbers Validated: _____

ITEM	YES	NO*
1. Are data calculations spot-checked by a second person?		
2. Do supervisory personnel review the data and QC results?		
3. Do QC records show corrective action when analytical results fail to meet QC criteria?		
4. Could the results of the samples validated be verified?		
5. Are all entries recorded in indelible ink?		
6. Are cross-out procedures followed?		

* If NO was checked, a corrective action report must be generated
N/A = Not Applicable
Comments:

SAMPLE COLLECTION FIELD AUDIT

Date: _____ County: _____

Audited by: _____ Facility: _____

ITEM	YES	NO*
1. Was a Quality Assurance Plan prepared for this activity? If yes, has it been approved by DER?		
2. Was there a map and a written list of sampling locations and descriptions available to field personnel?		
3. How many wells were sampled?	N/A	N/A
4. Were samples collected starting with the least likely contaminated and proceeding to the most likely contaminated?		
5. Were well depths determined?		
6. Were distances from top of casing to water determined?		
7. Are measurements taken to the nearest 0.01 foot?		
8. Describe how the depths were determined. _____		
9. Was measuring device properly decontaminated between wells?		
10. How was the volume of water originally present in each well determined? _____	N/A	N/A
11. Was the volume determined correctly?		
12. How was the completeness of purging determined?	N/A	N/A
13. Was a sufficient volume purged?		
14. Describe the method purging. _____	N/A	N/A
15. Were generators/gas pumps placed in down wind position from the well during operation?		
16. How were the samples collected?		

SAMPLE COLLECTION FIELD AUDIT (continued)

ITEM	YES	NO*
17. Was clean rope or line used with bailer at each well?		
18. Was sampling equipment protected from possible contamination prior to sample collection?		
19. Is care taken to avoid placing clean sampling equipment on the ground or other contaminated surfaces prior to insertion into the well?		
20. If equipment was cleaned in the field, were proper procedures used? (This includes storage method for rinse water & solvents.)		
21. Are the following labile (chemically unstable) parameters determined in the field:		
a. pH?	a.	
b. Temperature?	b.	
c. Specific Conductivity?	c.	
d. Redox potential?	d.	
e. Other (specify)	e.	
22. What field instruments were used during this investigation?	N/A	N/A
23. Were field instruments properly calibrated?		
24. Were calibration procedures documented in the field notes?		
25. Are adequate sample labels used?		
26. Were chain-of-custody records completed for all samples?		
27. Were all samples properly sealed at time of collection?		
28. Were samples locked in vehicle or kept in a secure place after collection?		
29. Is a field logbook maintained?		
30. Did the sampling personnel utilize any field/trip blanks?		
31. Did the sampling personnel utilize any preservative blanks?		

SAMPLE COLLECTION FIELD AUDIT (continued)

ITEM	YES	NO*
32. Were any equipment blanks collected?		
33. Were any duplicate samples collected?		
34. Were any spiked samples utilized?		
35. Were QA/QC samples specified in the QA plan?		
36. Were new disposable rubber gloves worn during collection of all samples?		

*If NO was checked, a corrective action report must be included with this report.

N/A = Not Applicable

Comments:

13.0 Preventative Maintenance

ATI's instrument maintenance program assigns the laboratory analysts the responsibility of performing preventive maintenance on specific instrumentation used in their work. The program consists of routine instrument performance checks (Table 8.1, Section 8.0, page 2-4) and a routine preventative maintenance schedule below.

All maintenance problems and their solutions are recorded on maintenance log forms (Figure 13.1).

Excessive down time is controlled by duplicating the major laboratory equipment. If an instrument fails, the sample load can be adjusted to a back-up instrument, if necessary.

13.1 Routine Preventative Maintenance Schedule

ATI's working definition of Preventative Maintenance is as follows:

Scheduled inspections and work done by laboratory analysts, supervisory personnel or instrumentation specialists for the purpose of 1) Enhancement of personnel safety, 2) Minimization of equipment downtime, and 3) Maximization of personnel/equipment performance and longevity.

Keys used in the following Preventive Maintenance Charts Figures 13.2 - 13.5, reflect the frequency of actions and the category of person responsible.

Frequency Descriptors

E = Each Use
D = Daily
W = Weekly
M = Monthly
Q = Quarterly
Y = Yearly
B = Prefix of BI (twice per period)
* = As needed, but not longer than otherwise specified

Responsible Person Descriptors

A = Analyst - Normal duties of chemist, technician, or operator
S = Supervisor - Requires additional knowledge on legal responsibilities
I = Instrumentation Specialist - Requires specialized electronic electrical, or other expertise.

Figure 13.1
Maintenance Log Form

Problem:

Solution:

Date/Time: _____ Technician _____ Instr. Repairman _____
Preventative Maintenance _____ Corrective Action _____

Problem:

Solution:

Date/Time: _____ Technician _____ Instr. Repairman _____
Preventative Maintenance _____ Corrective Action _____

Figure 13.2
GENERAL ANALYTICAL INSTRUMENTATION

	Furnace AA (2)	Flame AA (2)	UV-VIS Spectro- Photometer(3)	I.R. Spectro- Photometer(2)	Balances (5)	pH Meter (5)
Cleaning Nebulizer		D,A				
Clean Capillaries		D,A				
Drain Burner Systems		D,A				
Clean Burner Head		D,A				
Cleaning Contact Cylinders	D,A					
Changing Graphite Tubes	D,A					
Cleaning Furnace Windows	D,A					
Changing Contact Cylinders	W,A					
Check Lamp Alignment			D,A			
Check Fan Exhaust			D,A			
Clean Windows			Q,S	Q,I		
Clean Sample Cell				D,A		
Check Gas Leak				D,A		
Clean Pan					D,A	
Replace Light Bulb					Y,S	
Adjust Scale Deflection					Y,I	
Refill Electrodes						W,S
Clean Electrodes						D,A
Check 3rd Wire Leakage	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I

Figure 13.3
MASS SPECTROMETER DATA SYSTEMS

	Vacuum Pumps	M/S	Data Terminal	Computer Systems	Copiers	Disk Mag			Paper Data			Cooling Systems
						Drives	Tape	Reader	Tape	Systems	Backups	
Clean and/or Replace Air Filters		Q,I		Q,I	Q,I	Q,I	BY,I	Y,I	Y,I	Y,I		
Check Fluid/ Lubricant Levels	D,A		Q,I									D,A
Check Septums		*M,A										
Head Alignment						Q,I	BY,I	Y,I	Y,I	Y,I		
Check Nicad Back up Batteries				Q,I		Q,I						
Check 3rd Wire Leakage	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I		Y,I
Replace Fluids	Q,A											BY,I
Regenerate Foreline Traps	Q,A											
Check Powers Supplies		BY,I	BY,I	Q,I	Q,I	Q,I	BY,I	Y,I	Y,I	Y,I		
Check Ventilation Fans		W,A		Q,I		Q,I	BY,I	Y,I	Y,I	Y,I		D,A
Visually Inspect all Circuit Boards and Connections		Y,I	Y,I	Q,I	BY,I	BY,I	Y,I	Y,I	Y,I	Y,I		
Replace Brushes					BY,I							
Check/Fill Cal Fluid Vial		Q,A										
Check Gas Supply		D,A										
Clean Analyzer		Q,A										

Figure 13.4

GENERAL ANALYTICAL INSTRUMENTATION

	Gas Chromatograph	Purge & Trap Concentrator	HPLC	Dohrmann Tox	Battery Powered Meters
Replace the Septum	W,A *				
Replace Column	Q,A *		Y,A *		
Check Gas Flow	D,A		W,A		
Clean Injection Port	M,A *				
Clean Detector	M,A *				
Clean GC Syringes	D,A				
Replace Gas Purifier	Q,S				
Check Gas Supply	D,S				
Check Elect. Parts of Systems	Y,I	Y,I	Y,I	Y,I	Y,I
Check 3rd Wire Leakage	Y,I	Y,I	Y,I	Y,I	Y,I
Check for Leaks	D,A	D,A			
Change Purge Assembly		W,A			
Change Trap		Q,A *			
Check Trap Fan		W,A			
Replace Precolumn			Q,A *		
Back Flush Column			D,A		
Replace Detector Source			BY,I		
Clean Cell			Q,S		
Check all fittings for air leaks			D,A		
Check Pumphead Seals & Replace			BY,S *		
Check Valves & Clean			Q,A *		
Cleaning POX Sparger				D,A	
Inlet Tube Cleaning				W,A	
Leak Check Systems				D,A	
Check Battery Packs					BY,I

Figure 13.5

THERMAL AND MECHANICAL DEVICES

	Sample Standard Refr. (11)	Cooling Systems (2)	Ovens Incubators (8)	Hot Plates Digestors Dry Baths (16)	Stirrers Shakers Centrifuges (2)	Heating Mantles/ Controllers (27) (24)	(1)			Flash Point Tester	General Purpose Vacuum Pumps	Main Air Compressor
							Stillls (2)	Stills (2)	Stills (2)			
Check all Operational Indicators	D,A	D,A	D,A	E,A	E,A	E,A	E,A	E,A	E,A			
Check Out Put Temp.	D,A	D,A	D,A	E,A		D,A						
Clean Condenser Coils	Q,A											M,I
Check Thermally Exposed Connections and Wires	Y,I	BY,I	BY,I	BY,I	Y,I	BY,I	BY,I	BY,I	BY,I	BY,I	BY,I	BY,I
Check 3rd Wire Leakage Current	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I
Check Fluid Level		D,A								D,A	D,A	D,A

14.0 Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness

14.1 Precision

Precision is the statistical term referring to the reproducibility among replicate determinations. Precision data is accessed for each method parameter by analyzing a spiked sample in duplicate at least once per thirty analyses. Initial precision data is determined from the calculation of relative percent difference based on the first twenty duplicate determinations. (Ref. EPA 600- 4-79-019. March 1979 "EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories"). Precision control charts are then constructed based on the obtained data and updated every 6 months or at least 20 data points. The RPD like most precision statistics relates to a specific measurement range. Precision control charts are constructed based on the RPD data and the standard deviation of the average RPD.

The RPD is calculated for a specific concentration range based on the following calculations:

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100$$

14.2 Accuracy

Accuracy refers to the degree of difference between an observed value and a known or actual value. Accuracy is assessed by determining the percent recovery (%R) on quality control standards and spiked samples. Initial accuracy data is calculated based on twenty determinations and then updated every 6 months or at least 20 data points.

Accuracy control charts are constructed based on the %R data and the standard deviation of the %R. A minimum of one quality control and two spike samples per thirty determination. (10% QC) are analyzed on a continual basis. The calculation for percent recovery and standard deviation for the percent recovery are:

Percent Recovery for QC Standard:

$$\%R = \frac{\text{Measured Value}}{\text{Actual value}} \times 100$$

Percent Recovery for Spiked Samples:

$$\%R = \frac{\text{Measured Value} - \text{Background Value}}{\text{Value of Spike}} \times 100$$

Mean $\overline{\%R}$:

$$\overline{\%R} = \frac{\%R}{N}$$

Standard Deviation of the %R:

$$sd = \sqrt{\frac{(\%R - \overline{\%R})^2}{n - 1}}$$

n = number of determinations

Accuracy and initial calibration data for analytical methods are evaluated in terms of percent relative standard deviation (%RSD), and refers to the standard deviation as a percentage of the mean value. The initial calibration data must be within a specified %RSD or

$$\%RSD = \frac{sd}{x} \times 100$$

sd = standard deviation of x
 x = mean value of x

Fitness Test to Determine Outliers

Below is the test for determining "outlier" values in check sample data, which, if left in, would exert a significant effect on the overall data:

- (1) Compute the mean of all results in the set including questionable value(s).
- (2) Compute the plus or minus arithmetic deviation of each value in the set including the questionable value(s).
- (3) Compute the average arithmetic deviation of all values including the questionable value(s).
- (4) Compute the arithmetic deviation of each questionable value by subtracting it from the mean.
- (5) If the arithmetic deviation of a questionable value is higher than 2.3 times the average arithmetic deviation of all values including the questionable one(s), the questionable value is rejected as lying outside the 97% probability range.

14.3 Completeness

A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.

$$\text{Completeness} = \frac{\text{No. of valid QC tests}}{\text{Total no. of QC tests}} \times 100$$

14.4 Control Charts

Control charts are statistical tools for monitoring the performance of a particular task on a continuing basis. Quality control charts used at ATI monitor both precision and accuracy of all analytical methods used in evaluating water quality.

14.4a Accuracy Control Charts

The accuracy control chart monitors the percent recovery (% R) with standard deviation being the limiting control. The control charts are prepared for each test parameter after twenty determinations have been performed on quality control standards and spiked standards. The mean %R is plotted with the warning control limit (WCL) being plus and minus two standard deviations ($\pm 2sd$) and the upper and lower

control limits (UCL) and (LCL) respectively being plus and minus three standard deviations ($\pm 3sd$). In other words, the upper and lower warning limits are defined as the limits which would encompass 95% of the measured values for %R, and the upper and lower control limits are defined as the limits which would encompass 99% of the measured values of %R.

14.4b Precision Control Charts

The precision control chart monitors the repeatability of a measurement system disregarding accuracy. It is based on relative percent difference (RPD) which is defined as the absolute difference between duplicate determinations divided by the sum of the duplicate determinations after the sum of the duplicate determinations are divided by 2. The result is then multiplied by 100.

The formula for RPD is as follows:

$$\frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100$$

Where, X_1 = Sample Result
 X_2 = Sample Duplicate Result

14.4c Construction of Control Charts

Both precision and accuracy of control charts are prepared from historical data, and are constantly updated every 6 months or at least 20 data points. All the initial data used to prepare the control charts must be within the control limits established by the methodology and less than 5% of the initial data exceeding the upper or lower warning limits.

14.4d Interpretation of Control Charts

Control charts are designed to monitor test results for trends or failure of a particular test parameter. The controls used are accuracy and precision. The precision control chart is based on RPD which are absolute numbers. Therefore, values can never be less than zero. Interpretation of the chart is as follows:

Condition - Out of Control

1. Any point outside the upper control limit.

Condition-Critical Condition

1. Any point above upper warning limit.
2. Seven (7) successive points in the same direction causing an upward trend.

Condition-Satisfactory

1. Data is variable showing no trends and remaining below the warning limits.

The accuracy control chart is based on percent recovery data which may exhibit results exceeding upper and lower limits. In other words if a mean recovery of a particular test parameter is 95%, one may obtain results from 0 to several hundred percent but the control limits would constrain that data within certain boundaries such as 70% to 120%. These constraints are defined as lower and upper control limits respectively. Interpretation of this chart is as follows:

Condition - Out of Control

1. Any point outside the upper or lower control limits.

Condition - Critical Condition

1. Any point outside the upper or lower warning limits.
2. Seven successive points in the same direction causing either an upward or downward trend.
3. Ten successive points between the average recovery and UWL or ten successive points between the average recovery and LWL.

Condition - Satisfactory

1. Data is variable showing no trends and remaining within the warning limits.

15.0 Corrective Action

Corrective actions are taken when data is determined to be questionable or QC data is out of control. For each incident the corrective action is initiated by the Quality Assurance Officer and signed by each person involved. ATI will adhere to any corrective action deemed necessary by FDER.

15.1 Corrective Action Limits

Each analytical method has established accuracy limits. These limits are constantly updated with the accumulation of accuracy data from the analysis of spiked samples and quality control standards.

The accumulated data is used to construct accuracy and precision control charts which are used to determine the acceptability of data on a continuous basis. The initial measurement system must achieve the accuracy limits defined in each method. If any QC check falls outside these limits then for precision or accuracy, corrective action is taken to bring the QC check back within the control limits before any sample may be analyzed.

15.2 Corrective Action for Field Activities

Corrective actions will be taken any time when deemed necessary by an auditing agency (FDER) or ATI's Quality Assurance Officer. Problems with field quality control may result from contamination of field blanks or contamination of field equipment and supplies either during the cleaning/loadout process or during field operations. Corrective actions must be taken any time when the data or field procedures are of questionable quality. These actions may include modifying certain procedures to reconducting an entire field investigation. The QA Officer shall be notified of any suspected problems. A Corrective Action Plan shall be developed in cooperation with the Quality Assurance Officer.

16.0 Quality Assurance Report to Management

The Quality Assurance (QA) Officer will provide an interim and final QA report on the QA activities for specific projects. An interim report will only be prepared for projects lasting more than 3 months.

The contents of both reports will be similar, except the final report will include a summary of the interim report. The reports will contain the following information:

1. A statistical assessment of accuracy and precision data and measurement of completeness.
2. Results from system and performance audits during the report period; and
3. Non-compliance reports which contain all pertinent data, a description of the QA problem and the corrective action.

The QA reports will be submitted to the Project Manager. The QA reports will also be transmitted to the Florida Department of Environmental Regulation (FDER) QA Officer by the Project Manager for all projects. Below is a schedule of how reports will be submitted (Table 16.1).

Table 16.1

Quality Assurance Reports Submittal Frequency

PROJECT TYPE	PROJECT DESCRIPTION	FREQUENCY
On-going monitoring Projects	Dependent on the frequency of sampling: Weekly, biweekly or monthly Bimonthly, quarterly semiannual	Semiannual Annual
All projects related to Chapter 17-770, F.A.C.	Not applicable	Annual Reports for each Quality Assurance Project Plan for Under-ground Storage Tanks
Other projects not specifically defined in the above descriptions	Up to two years Greater than two years	One final report One report every years, and a final report

Quality Assurance reports will be submitted only for corrective actions in the project or a letter stating that there were problems during the project.

17.0 Personnel Qualifications

The resumes of Analytical Technologies, Inc. key personnel are attached.

ANALYTICAL TECHNOLOGIES, INC. PROFESSIONAL RESUME

W. Faye Bowers, B.S.
Laboratory Manager

SPECIALIZATION

Manager of the overall financial and technical aspects of the laboratory and Environmental Consultant.

RECENT EXPERIENCE

Laboratory Manager, 1988 to Present--Responsible for all data reported by Analytical Technologies, Inc. The responsibilities include project design and implementation, quality assurance and quality control, personnel management, legal assistance, environmental consulting, industrial hygiene, public relations and financial support and management. Review operations of each reporting function on a regular basis and support the development and implementation of the quality control program to maintain an excellent reputation in the environmental field.

PAST EXPERIENCE

President/Manager, 1979 to 1988---Founded Analytical Technologies, Inc. (formerly Pioneer Laboratory, Inc.) in 1979. Responsible for all data reported by Analytical Technologies, Inc.

Technical Director, 1978 to 1979--Was Responsible for all technical aspects of Analytical Technologies, Inc.

Laboratory Supervisor for environmental and immunology laboratories. Industrial Hygienist for personal and ambient air monitoring programs. Duties included implementing ambient air monitoring programs for the detection of low boiling alcohols, nitrosamines and particulate ammonium nitrate.

EDUCATION

B.S., Chemistry, University of West Florida, 1971.

CERTIFICATIONS

NIOSH asbestos certification, 1986

AFFILIATIONS

American Institute of Chemists, 1986
Florida Society of Environmental Analysts, 1982
American Chemical Society, 1971

ANALYTICAL TECHNOLOGIES, INC. PROFESSIONAL RESUME

Kelly S. Swanson, B.S.
Quality Assurance Officer

SPECIALIZATION

Over two years laboratory experience analyzing water/wastewater for various organic and inorganic parameters.

Two years experience in auditing for the State of Florida.

RECENT EXPERIENCE

Quality Assurance Officer, August 1990 to Present--Responsibilities include systems and performance audits, preparing and implementing Quality Assurance/Quality Control (QA/QC) plans, and preparing QC reports and QC samples. Also responsible for in-state and out-of-state certifications/accreditations, monitoring the laboratory QC, and helping to educate laboratory personnel in the knowledge of QA/QC.

PAST EXPERIENCE

HRS - Office of Laboratory Services, State of Florida, Chemist III/Laboratory Consultant, September 1988 - August 1990. Responsible for inspecting water testing laboratories for the State of Florida Water Certification Program with the ultimate goal being to improve laboratory performance and quality of work generated.

Seminole County, Chemist, May 1986 - September 1988. Responsible for the analysis of water/wastewater samples.

EDUCATION

B.S., Chemistry, University of Central Florida, 1985.

ANALYTICAL TECHNOLOGIES, INC. PROFESSIONAL RESUME

John V. Hawkins, B.A.
GC/MS/Air Pollution Director

SPECIALIZATION

Over 8 years experience in chemical laboratory operations as manager and GC/MS Supervisor.

RECENT EXPERIENCE

GC/MS Director, Client Services Director, December 1988 to Present.
Responsible for overseeing all aspects of the GC/MS Laboratory. In addition has served as Director of Client Services, with emphasis on technical coordination of organics analysis related projects.

PAST EXPERIENCE

Senior Chemist, GC/MS Group Leader for Research Triangle Laboratories. Responsible for accurate and precise analysis of environmental and forensic samples. Integrate training of employees in proper analytical techniques. Consulting with clients to develop sampling and analysis schemes at landfills, hazardous waste sites, incinerator trial burns and other critical situations. Specific expertise in VOST, SEMI-VOST and ambient testing methods as set forth in SE-846 and the EPA Compendium of Ambient Methods 1-14, and forensic samples.

Acting Laboratory Manager, Research Triangle Laboratories.
Accountable to corporate stockholders for the safe, efficient operation of air pollution laboratory. Directed scheduling, product sales and analytical programs while coordinating efforts of twelve employees.

GC/MS Chemist, Research Triangle Laboratories.

GC/MS Section Head, Roche Biomedical Laboratories.

Bench Chemist, Roche Biomedical Laboratories.

EDUCATION

B.A. Chemistry, University of North Carolina at Greensboro, 1983.

AFFILIATIONS

Air Pollution Control Association (APCA)
Commercial Laboratory Association of North Carolina, Vice-President,
1987-1988.

ANALYTICAL TECHNOLOGIES, INC. PROFESSIONAL RESUME

Susan Rembert, B.S.
Assistant Manager

SPECIALIZATION

Over four years in chemical laboratory operations.

RECENT EXPERIENCE

Assistant Manager, November 1990 - Present: Responsible for assisting the General Manager in all aspects of laboratory direction: Project design and implementation, quality assurance and quality control, personnel management, legal assistance, environmental consulting, public relations and financial support and management. Assists in reviewing operations of each reporting function on a regular basis and support the development and implementation of the quality control program to maintain an excellent reputation in the environmental field.

PAST EXPERIENCE

Client Services Director, August 1990 - November 1990--Responsibilities include coordination and management of client projects. Also maintaining the Client Services Department in accordance with customer needs and expectations.

Quality Assurance Officer, October 1987 to August 1990--Responsibilities include systems and performance audits, preparing and implementing Quality Assurance/Quality Control (QA/QC) plans, and preparing QC reports and QC samples.

GC/MS Supervisor, June 1987 to October 1987--Responsibilities include managing 5 technicians performing volatile and semi-volatile analysis following EPA Methods. Also responsible for training technicians, quality control, data documentation and review, 4 GC's equipped with FID, PID, and HALL detectors, 4 GC/MS, and a TOX analyzer.

Laboratory Technician, August 1986 to June 1987--Responsibilities include analyzing samples for TOC, TOH, and volatiles by GC/MS.

Two years experience working in a geological laboratory. Duties include stratigraphical mapping, structural identification, identification of economically important minerals, identification of fossils and interpreting well logs.

Five years experience in personnel and data management.

EDUCATION

B.S., Geology, University of South Alabama, 1986
Sigma Gamma Epsilon

CERTIFICATIONS

Florida Teaching Certificate, 1986-Present

AFFILIATIONS

Association of Petroleum Geologist, 1984 to Present

ANALYTICAL TECHNOLOGIES, INC. PROFESSIONAL RESUME

Kathy Avery, A.S.
Office Manager

SPECIALIZATION

Over 2 years experience overseeing office management.

RECENT EXPERIENCE

Office Manager, June 1989 to Present---Responsibilities include supervising four (4) people, handling all personnel paperwork, all insurance questions, overseeing the Data Management department and all accounting.

Assistant Bookkeeper/Reporting Manager, May 1986 to June 1989---Responsibilities included invoicing reports, database reorganization credit and debit memos, talking to customers about past due accounts and wrong invoice amounts, accounts receivable & payable, cash receipts, filing, making out deposit slips for checks. Also the operation of an IBM System 36, IBM PC, Kaypro PC, IBM Personal Wheelwriter, Toshiba printers, and Hewlett Packard Laser Printers.

EDUCATION

A.S., Executive Secretary, Pensacola Junior College, 1986.

ANALYTICAL TECHNOLOGIES, INC. PROFESSIONAL RESUME

Jerry W. Dees, B.S.

Client Services Representative/Field Personnel Supervisor

SPECIALIZATION

Over 3 years experience in Industrial waste sample collection, field analysis and laboratory analysis, mostly biological and inorganic. Wastewater analysis.

RECENT EXPERIENCE

Client Services Representative/Field Supervisor October, 1990 - Present--Responsible for overseeing field personnel and packing for shipment and client orders. As Client Services Representative, responsible for taking on client projects and handling any situations that may arise. As the Laboratory Safety Officer, responsible for ensuring all aspects of safety measures in and around the laboratory. Handles certain clients and their ongoing projects in cooperation and accordance with Client Services.

PAST EXPERIENCE

Sample Custody, April 1990 - October 1990--Responsible for overseeing sample custodians, bottle preparations, field personnel and packing for shipment and client orders. As the Laboratory Safety Officer, responsible for ensuring all aspects of safety measures in and around the laboratory. Handles certain clients and their ongoing projects in cooperation and accordance with Client Services.

Client Services Contract Chemist, July 1989 - April 1990---Responsibilities included talking to clients for types of analysis they require and handling any problems or projects they need service on.

Chemist for an Industrial Waste Laboratory in San Diego, California for approximately 2 years.

Laboratory Supervisor for City Government for approximately 4 months.

EDUCATION

B. S. Chemistry and Biology, Lee College, Cleveland, Tennessee, 1977.

HONORS

Alpha Chi National Honor Society
Summa Cum Laude graduate

PUBLICATIONS

Author and Co-author of six publications concerning research sponsored by N.S.I. and Oak Ridge National Research Laboratories.

ANALYTICAL TECHNOLOGIES, INC. PROFESSIONAL RESUME

Daryl D. Dempsey, B.S.
GC Organic Supervisor

SPECIALIZATION

Over 8 years of diversified analytical experience coupled with 3 years consulting experience covering the full range of analyses on hazardous and toxic wastes, municipal and industrial sludges, soils,

RECENT EXPERIENCE

GC Organic Supervisor, May 1989 - Present.

Responsibilities include supervising and training 10 laboratory technicians for the analysis of Pesticides and PCBs, Herbicides, Volatile Organics by GC, TOC, Oil and Grease, following EPA Methods. Also responsible for quality control, data documentation and review, tracking samples through the Organic Department, and extractions.

PAST EXPERIENCE

Experienced in the supervision of a technical and clerical staff, and report writing. Have broad experience in the planning and execution of analytical approaches, in making practical applications of this data, and in solving client problems in the environmental field. Have worked with decision makers at all levels in industrial, municipal, state, and federal organizations.

EDUCATION

B.S. Environmental Science, Western Kentucky University, 1979, with a minor in Chemistry and Biology.

ANALYTICAL TECHNOLOGIES, INC. PROFESSIONAL RESUME

Kenneth Holloway
Associate Chemist

SPECIALIZATION

Seventeen years laboratory experience in refining, oil field drilling and water treatment.

RECENT EXPERIENCE

GC/VOA Supervisor, August 1990 to Present--Supervise ten technicians performing volatile analysis by EPA methods. Also responsible for training technicians, quality control, data documentation and review, equipment maintenance, parts and standards inventory.

PAST EXPERIENCE

GC/VOA-GC/MS Supervisor, October, 1987 to August 1990--Supervised 14 technicians performing volatile and semivolatile analysis by EPA methods. Was also responsible for training technicians, quality control, data documentation and review, equipment maintenance, parts and standards inventory.

GC Technician from June, 1987 to October, 1987

Gulf Oil Laboratory Analyst from 1970 to 1976.

Shepard Oil Refining Laboratory Consultant from 1976 to 1977.

Newport Waste Treatment Assistant Manager, 1980.

Oil Field Drilling Fluids Engineer from 1977 to 1979 and from 1981 to 1986.

EDUCATION

Chemistry, Louisiana State University, New Orleans Branch, 1969-1970

CERTIFICATIONS

Gulf Oil Laboratory Analyst, Graduated head of class, 1970-1973

Drilling Fluids Engineer, Milchem School, Houston, Texas, 1977

Approved Fluids Consultant for major petroleum companies, 1977-1986.

ANALYTICAL TECHNOLOGIES, INC. PROFESSIONAL RESUME

Peter J. Shuba, Ph.D.
Client Services Director

SPECIALIZATION

Over twenty years experience testing sludge, sediments, and wastewaters for biological and chemical parameters.

RECENT EXPERIENCE

Client Services Director, November 1990 - Present: Responsibilities include coordination and management of client projects. Also maintaining the Client Services Department in accordance with customer needs and expectations.

PAST EXPERIENCE

Client Services Representative, April 1990 - November 1990: Responsibilities include project management and assisting clients with their projects and needs. Also, reviews analytical data, provides pricing information and bottle shuttles.

Consultant, Environmental and Regulatory Services for 8 years providing consulting services to clients in relation to state and federal regulations, including Marine Protection, Research and Sanctuaries Act (MPRSA), Federal Water Pollution Control Act (FWPCA), Toxic Substances Control Act (TOSCA), National Pollutant Discharge Elimination System (NPDES), Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and Resource Conservation and Recovery Act (RCRA) for permit applications and chemical registrations.

Laboratory Manager for EG&G Bionomics Marine Research Laboratory, Pensacola, Florida, for 3 years in toxicity testing and environmental field studies.

Senior Scientist for EG&G Bionomics Marine Research Laboratory, Pensacola, Florida assisting in planning, conducting and analyzing results of toxicity tests with freshwater, marine and estuarine plants and animals largely in dredged sediments, drilling muds, industrial effluents, and other complex wastes and wastewaters.

Research Biologist for U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. Principal Investigator of the biological assessment program.

Assistant Professor of Microbiology for University of Florida, Gainesville, Florida. Teaching Biology and Microbiology to undergraduates as well as some graduate level.

Graduate Teaching and Research Assistant, Department of Microbiology, University of Florida, Gainesville, Florida.

EDUCATION

Ph.D., Microbiology, University of Florida, Gainesville, 1973.
M.S., Bacteriology, University of Florida, Gainesville, 1970.
B.S., Biology, Fitchburg State College, Fitchburg, Massachusetts, 1967.

AFFILIATIONS

American Society of Testing and Materials, Present
Society of Environmental Toxicology and Chemistry, Present
GE_SG001221

ANALYTICAL TECHNOLOGIES, INC. PROFESSIONAL RESUME

W. F. Robin Robinson, B.S.
Inorganic Supervisor

SPECIALIZATION

Over five years of scientific observation, Data collection and program development experience.

RECENT EXPERIENCE

Inorganic Supervisor, November 1990 to Present: Responsibilities include supervising 15 technicians in the Inorganic Department, evaluating data, training technicians, maintaining the Quality Control Program, and sample custody and preparation. Instrumentation responsible for include ICP, 3 AAs, Mercury Analyzer, 2 spectrophotometers, 2 ion specific electrode meters, 5 pH meters, 3 DO meters, 2 turbidimeters, 2 conductivity meters and a flash point apparatus.

PAST EXPERIENCE

Asbestos/Radon Group Leader April 1989 to November 1990--Responsible for overseeing all aspects of the laboratory and field related functions, i.e., coordinating the flow of asbestos projects, Asbestos Quality Control supervisor, training of asbestos personnel.

Developed and refined laboratory-field protocols to acquire NVLAP Accreditation, Radon proficiency testing success. Author of Pioneer Laboratory's Asbestos/Radon Procedures/Quality Control Manual. Successfully managed a family-owned business for several years.

EDUCATION

B.S., Biology, University of West Florida, 1988

CERTIFICATIONS

Licensed Practical Nurse

Asbestos in Buildings: Inspection and Assessment (LIC.#1544), The Environmental Institute, Atlanta, Georgia (August, 1989)

Asbestos in Buildings: The Management Plan (LIC.#1349). (August, 1989)

Asbestos Fiber Counting (NIOSH 582), The McCrone Research Institute, (October, 1989)

Advanced Asbestos Identification, The McCrone Research Institute, Chicago, Illinois (October, 1989)

Quality Control for Asbestos Analysis Laboratories, Environmental Training Corporation, Raleigh, N.C. (April 1990)

HONORS

Dean's List for entire education at the University of West Florida.

ANALYTICAL TECHNOLOGIES, INC. PROFESSIONAL RESUME

Melissa L. Pope, B.S.

Client Services Assistant/Sample Log-in Supervisor

SPECIALIZATION

Over two years experience in the areas of reporting/Data management, sample log-in, sample shuttle, and client services.

RECENT EXPERIENCE

Client Services Assistant/Sample Log-in Supervisor, October 15, 1989 - Present -- Responsibilities include coordinating special projects, marketing, production support of shipping and receiving, technical review and customer service. Oversees incoming samples, bottle orders and supervising 4 log-in technicians.

PAST EXPERIENCE

Sample Custodian, December 5, 1988 - October 15, 1989 -- Responsibilities included sample log-in, bottle orders, sample custody procedures, bottle inspection and identification. Worked on the System 36, Wordprocessor, Lotus and Wordstar 5.

Technical Reporter, September 21, 1988 - December 4, 1988 -- Responsibilities included typing in technician results, typing letters, filing, and backup.

EDUCATION

B.S., Health, Leisure and Sports, University of West Florida, 1988.